THE BIOLOGICAL DISPOSAL OF SEWAGE FROM ISOLATED BUILDINGS.

By Professor FRANK CLOWES, D.Sc.

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INTRODUCTORY.

THE present Paper deals with the application of the biological method of treatment to the sewage from the new colony established at Horsham in the buildings erected by Messrs. Aston Webb, R.A., and Ingress Bell. When asked by Mr. Webb, at the suggestion of Dr. Armstrong, to recommend a means of inoffensively disposing of the sewage from Christ's Hospital, the experience derived from several years' biological treatment of a portion of the London sewage led me unhesitatingly to recommend the erection of a plant precisely similar to that used in the London experimental work. It seemed certain that the treatment at Horsham would be simplified by the fact that the sewage is purely of domestic origin. It accordingly contains no water derived from rainfall or surface drainage, and no road detritus or other matters which are not present in house drainage. Even the laundry refuse-water is excluded from this sewage, an arrangement which is probably not altogether in favour of the biological method of treatment, since the alkalinity caused by soap appears to favour bacterial action.

The system adopted consists in passing the sewage slowly through a depositing, or so-called "septic," tank, and allowing the outflow from this tank to be dealt with intermittently in coke-beds. The effluent from the tank, after having been treated once in the coke-bed, passes into a running brook, flowing as a matter of convenience over a short stretch of grass-land on its way.

EXPLANATION OF BIOLOGICAL TREATMENT AND OF THE METHOD OF ADAPTING IT.

It may be explained that the general advantages secured by the so-called biological or bacterial method of treatment are that it secures an inoffensive and non-putrescible effluent, and at the same time largely reduces the amount of sediment or "sludge" from town sewage which has to be disposed of; in the case of domestic sewage it even removes the sludge altogether.

Many kinds of living organisms undoubtedly take part in the changes brought about in this process of purifying sewage; hence the term "biological" or "natural" has been applied to the treatment. Since, however, the excessively minute vegetable organisms known as bacteria constitute by far the largest proportion of these useful organisms, the treatment is frequently termed "bacterial." The bacteria are actually present as organisms and as living spores in the sewage itself, and require to establish themselves in the purifying plant before the treatment becomes efficient. The improvement noticeable in the purification as

the tank and coke-beds mature is probably explained by the fact that the bacteria gradually accumulate and accommodate themselves to the conditions under which they are placed.

It has been found that many species of bacteria are concerned in the process, and that some, acting anaërobically, or in the absence of air, play their useful part in the settling or "septic" tank, whilst others, which require to be freely supplied with air and are therefore termed "aërobic," complete the purification in the subsequent coke-bed treatment. The sewage is prepared by the preliminary passage through the septic tank for the final purification in the coke-beds. It is in the septic tank that the solid faecal matter is resolved by the bacteria into gaseous and liquid substances, and it is here that the suspended solids disappear. It has been stated that the liquid should be secluded from contact with air during this preliminary treatment, but in order to secure this it is unnecessary to cover the tank, since the solid matters float as a protective scum and prevent the contact of the liquid with the air; and even when this scum is removed by wind or by rain the bacterial action is apparently not seriously affected. The complete closing of the tank is attended with some danger, since the gas produced is inflammable, and the introduction of a spark or flame into the inclosed space might therefore be attended with fire or explosion.

The final treatment in the coke-beds in the presence of air, constituting the so-called aërobic treatment, is mainly brought about by species of bacteria different from those concerned in the preliminary aërobic treatment, although some bacteria exist which are termed "facultative" because they have the power of adapting themselves to either aërobic or anaërobic conditions.

There are two recognised methods for exposing the sewage liquid to the action of aërobic bacteria. The "continuous method" provides for the liquid which overflows from the septic tank being continuously sprayed over the coke-beds, through which it constantly trickles and then flows away; whilst the "intermittent method" provides for the coke-bed being filled with the liquid, and then drained away after it has remained in the bed for a few hours.

The beds used in the continuous method are usually deep; they are made of large, hard material, and should be open at the sides; they possess the advantage of not requiring the constant services of an attendant for opening and closing the valves; but the final effluent from these beds must be subjected to sedimentation, since it contains much black humus-like suspended matter.

The beds used for the "intermittent treatment" are usually made of smaller material, since they have been found to be more efficient when filled with small coke than with large; they have been made of any depth up to thirteen feet.

Both these methods, when properly arranged and worked, yield a perfectly satisfactory effluent, and one or other should be chosen, according to the conditions under which the sewage is to be purified; probably where the fall of ground is sufficient the continuous treatment would frequently have the preference. In the present case the intermittent method was recommended because the writer had successfully worked it for many years, and at the time of drawing out the plans the continuous treatment had not been so fully experimented upon as at the present time, and could hardly come under consideration.

As regards cost of construction, this will naturally vary much with the style of work adopted. The plant for continuous treatment would probably be in most cases more expensive than that for intermittent, but on the other hand the cost of working it would be less. The extra cost of working the valves in the intermittent system is, however, usually reduced by the fact that there is a man about the place engaged in other work who can attend to the valves, and it is also quite possible to make the action automatic.

In calculating the capacity of the coke-beds for the intermittent system, it may be stated generally that the liquid capacity of the tank is reduced by about 50 per cent. by being filled with coke fragments. The capacity after the coke has been introduced, however, continually decreases for a period after the bed has begun to receive sewage, owing to the growth on the coke surface of a gelatinous film. The growth of this film is essential, as it includes the active bacteria; it further possesses the useful property of absorbing atmospheric oxygen when the bed is empty, and giving it up for purifying purposes to the sewage liquid which is subsequently introduced. The average working capacity of a well-managed bed, after the capacity has become stationary, may be put down at about 25 per cent. of the original space before the introduction of the coke.

It may be noted that the cooling of the sewage by frosty weather somewhat reduces the activity of the purifying organisms, although they continue to exert some purifying effect even in a liquid which is frozen on its surface, and they survive even after the liquid has been entirely frozen. Indeed, it has been shown that bacteria survive after exposure to the extremely low temperature of liquid air. But the fact that low temperature tends to render the biological purification less rapid tells in favour of the intermittent treatment during cold weather, since the spraying of the liquid through the air in the continuous treatment tends to greatly reduce its temperature.

In designing a plant for intermittent biological treatment, it is usual to assume that the water supply amounts to 30 gallons per head, and that the supply calculated on this basis represents the sewage flow to be arranged for. The septic tank should have a capacity of one day's flow, and the coke-beds collectively should be able to hold a two days' flow, their depth being determined by local conditions. It is assumed that the beds will receive two fillings in twenty-four hours, and that their working capacity will be 25 per cent. of the space which is afterwards filled with coke.

GENERAL RESULTS OBTAINED.

Before describing the construction of the plant and the method of using it, it may be stated that the treatment has now been in operation for over eighteen months, under the general charge of Mr. Streeter, of the works department, and has been worked by his man. Mr. Streeter reports that no hitch has occurred in the working of the plant, and that on one occasion only has any offensive smell arisen from the treatment. On examining into the cause of this smell, I found that it arose from stagnation of the process during the first lengthy school vacation. In the treatment of London sewage no intermission of flow occurs, but in a teaching establishment the sewage-flow almost ceases during vacation time. The first school vacation accordingly taught us that some means must be adopted to prevent the sewage from remaining unduly long in the septic tank, an occurrence which was new and unforeseen. The stagnation of the septic tank led to the production in the sewage of a large amount of sulphuretted hydrogen, and this foul gas was freely smelt when the school resumed its work, and the liquid in the tank was accordingly displaced. The liquid in the tank was not only offensive in smell, but it also undoubtedly upset the bacterial action of the coke-beds; it was, therefore, of a wholly objectionable nature. Attention is specially drawn to this occurrence and to its cause, because it probably explains why similar installations for the treatment of sewage from isolated buildings have become offensive. The plant should receive a flow of sewage which is sufficiently regular to prevent lengthy stagnation; and such stagnation might probably be obviated in all cases, as it was obviated in subsequent vacations

at Horsham, by arranging that a sufficient amount of water should pass through the tank during lengthy periods of cessation of sewage flow.

With the above exception, and throughout the period when regular working has been maintained, no offence has arisen, and the final effluent into the stream has been shown by frequent observation and by examination in the laboratory to be free from matter which could lead to offence even during hot and droughty summer weather.

The solid fæcal matter of the sewage is absolutely disposed of in the septic tank, and no deposit has formed upon the bottom of the tank. The fear had been expressed that this tank might become offensive, but this fear has been proved to be groundless, since the ventilators in the roof of the tank and the open man-holes emit no offensive smell, and the smell of the effluent itself is slight, and is only noticeable in the immediate vicinity of the tank. The final effluent liquid from the coke-bed is usually slightly turbid, but it is free from any offensive odour; it possesses only the smell of freshly turned garden mould, and this is the odour which is usually emitted from wholesome effluents.

Careful examination of the sewage and of the final effluent shows that the number of bacterial organisms in the sewage becomes considerably reduced during the treatment, and there can be no doubt that those organisms which remain in the effluent are useful in effecting its further purification after it has passed from the coke-beds.

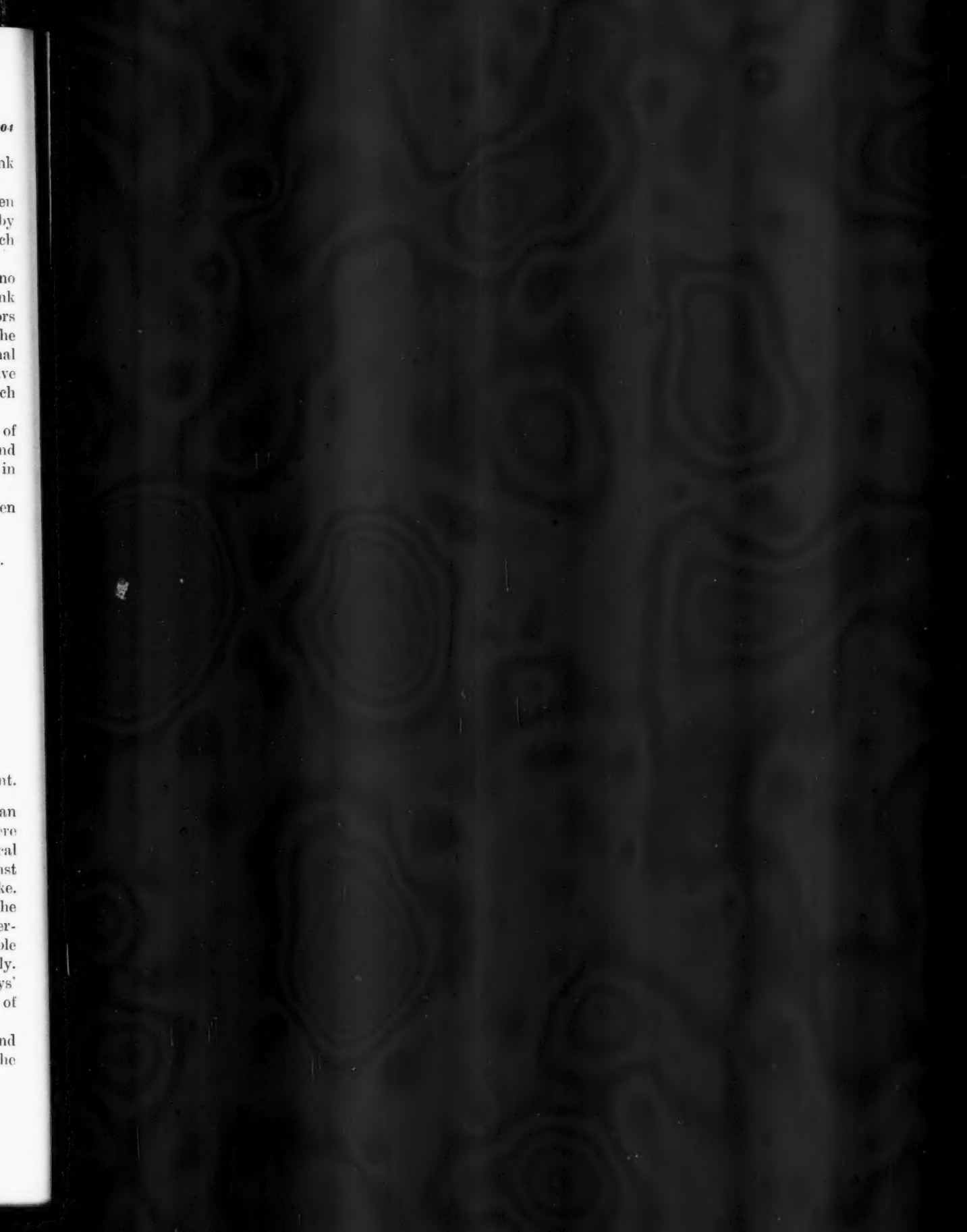
A general summary of the results of the bacterial and chemical examination has been prepared, and the following are the average results obtained:—

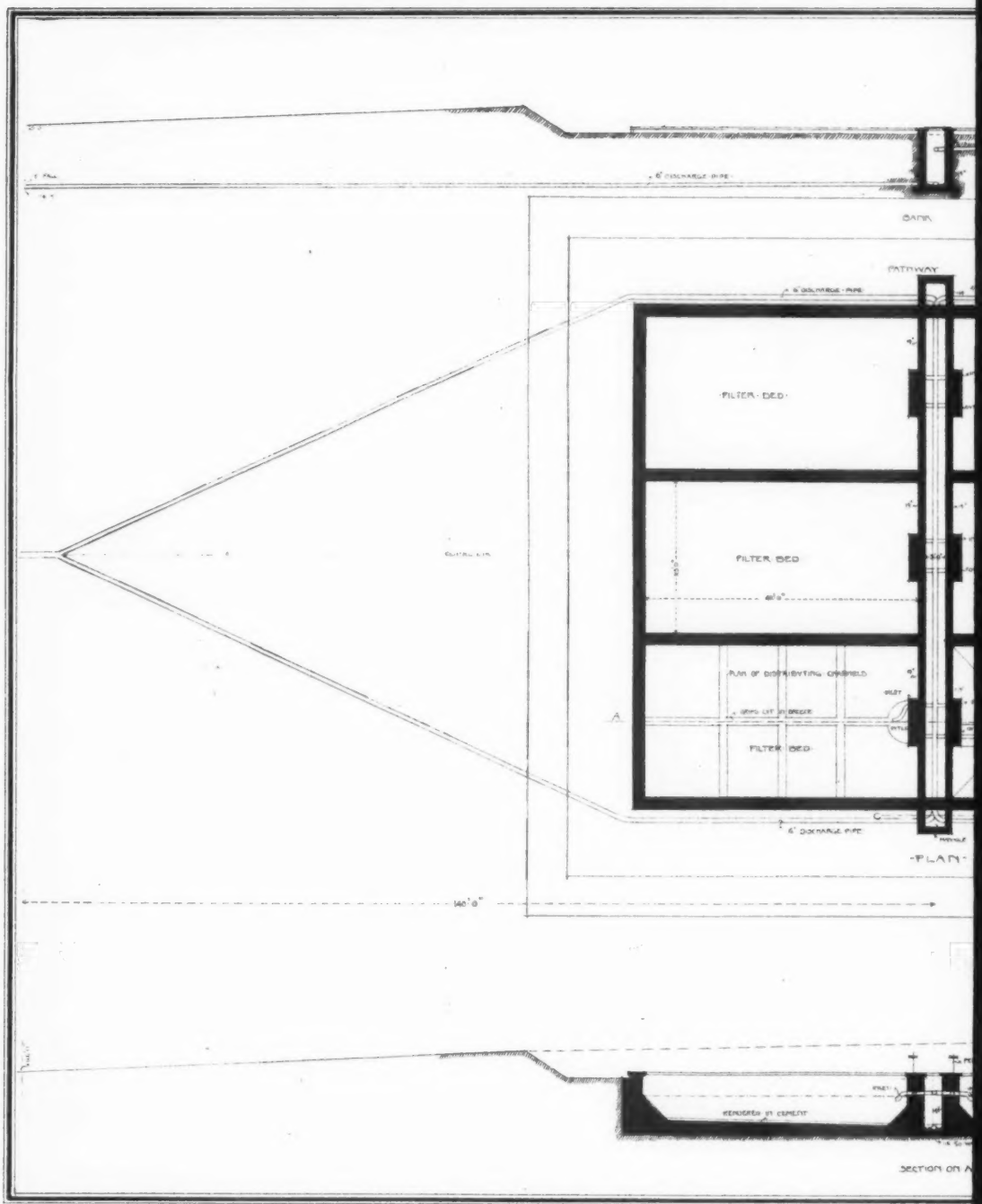
Bacterial examination:—	Per cubic centimetre.
Number of bacteria in the liquid portion of the sewage	12,492,857
Number of bacteria in the septic tank effluent	10,514,285
Number of bacteria in the final effluent	8,464,285
Percentage decrease in number by treatment	32·2

Chemical examination of final effluent:—		Parts per 100,000.
Oxygen absorbed from permanganate	in 15 minutes	0·65
	in 4 hours	1·03
Albumenoid ammonia		0·33
Ammonia		2·06
Sulphuretted hydrogen		None
Dissolved atmospheric oxygen		30 per cent. of the possible amount.

An effluent of this character has been found to sustain the respiration of fish for an indefinite length of time. In the early trials at Horsham, however, the fish which were immersed in the effluent lived for four days only, and appear to have succumbed to mechanical injury occasioned either by the violence of the outflowing stream which dashed them against the wire netting, or to the somewhat crude method of capture by means of a garden rake. The trials have been recently repeated with healthy uninjured fish in the still effluent, and the fish continued to live and thrive for a fortnight, when they were removed. A special determination made on the 30th ulto. showed that the effluent contained 30 per cent. of the possible amount of atmospheric oxygen in solution, and in such an effluent fish can breathe readily. It was further found that the oxygen dissolved in the effluent was not removed by 10 days' incubation at 80° F. in a closed bottle. This effluent would certainly improve the condition of the water of a brook which had been fouled by ordinary sewage or cesspool discharges.

It may be confidently stated that the experience derived from the construction and working of the plant in question has given assurance that it is suitable to deal with the





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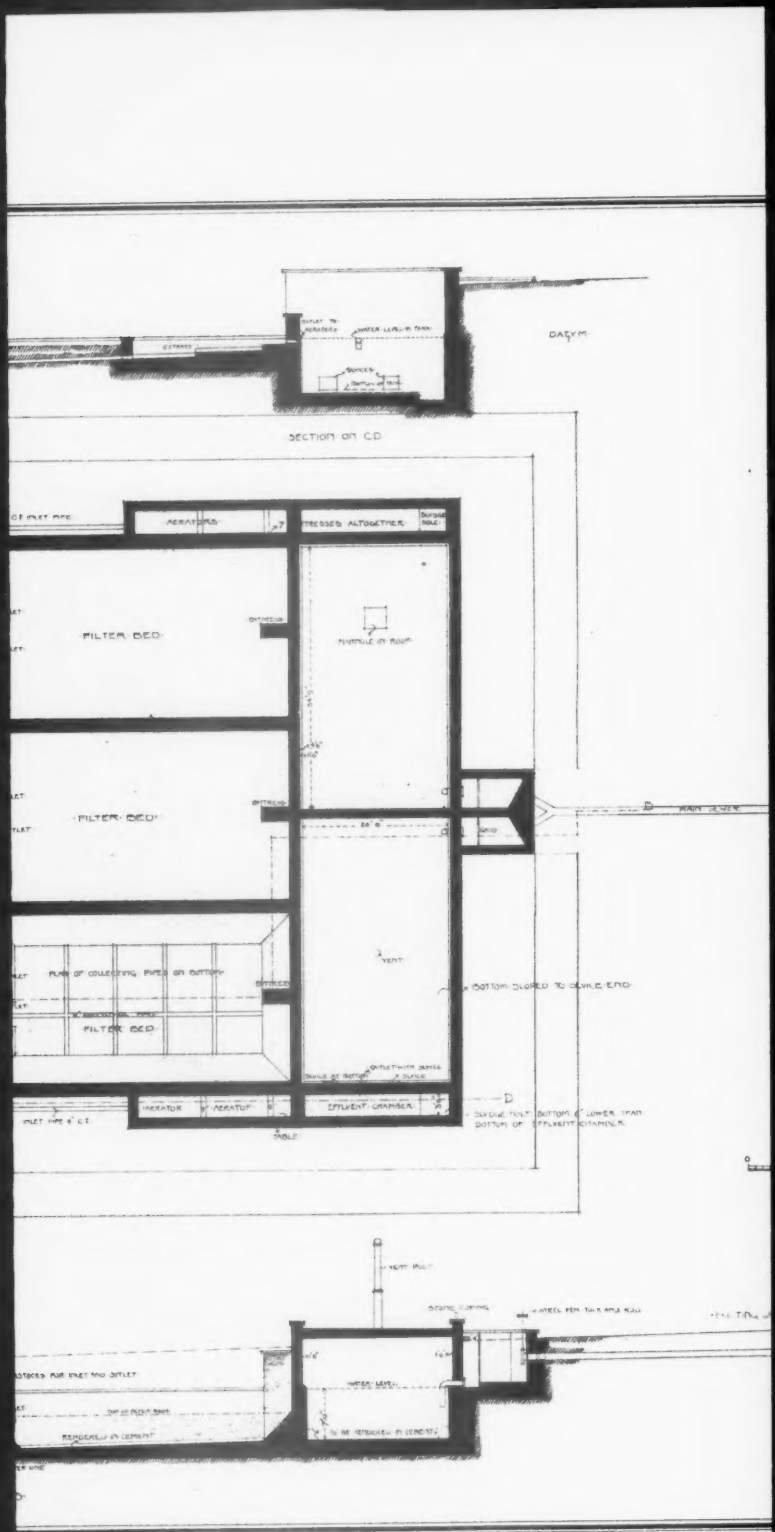
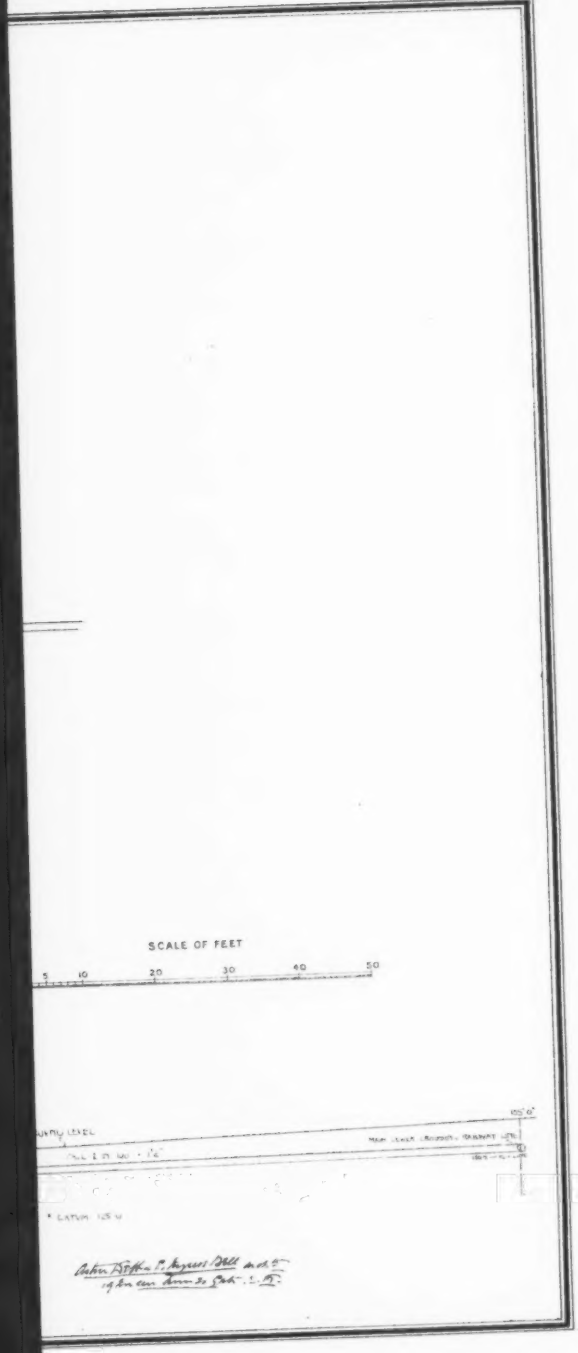


HORSHAM. PLAN OF SEPTIC TANKS.

FIG. I.



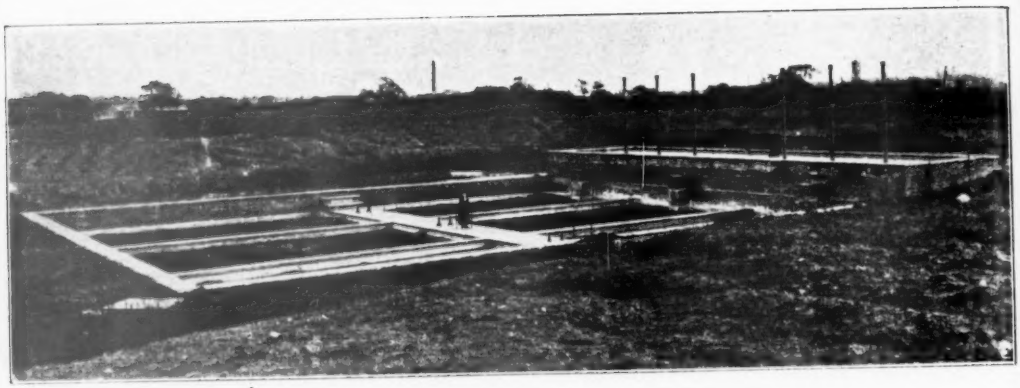


FIG. 2.

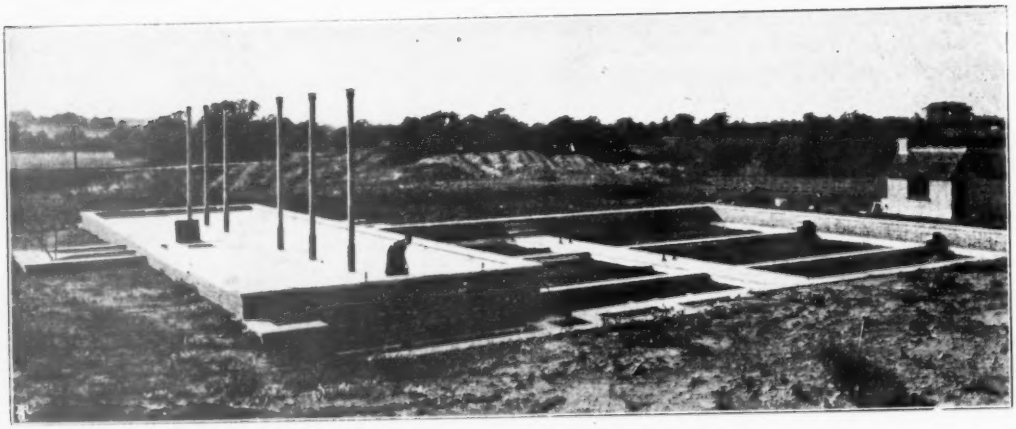


FIG. 3.

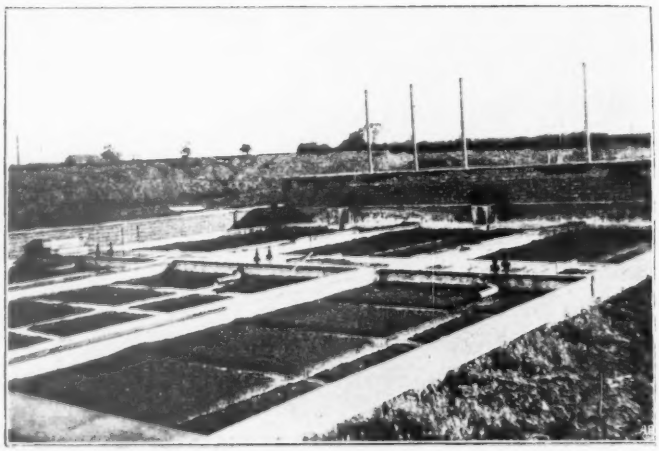


FIG. 4.

sewage derived from any isolated building without giving offence. It is also certain that under proper management the sewage effluent which it discharges will be innocuous to fish, and will not become offensive in itself or when it is discharged into a watercourse. It will be understood that proper management implies a certain regularity of working, which might doubtless be largely automatic in its nature.

DETAILS OF CONSTRUCTION AND TREATMENT.

The accompanying drawing of the plan and section (fig. 1) has been kindly furnished to me by Mr. Webb.

In planning the construction of the plant it was assumed that the amount of sewage to be dealt with would be thirty-five gallons per head of those resident at the school, and that the number of residents would be one thousand.

The sewage flows by gravitation into a small receiving chamber, and passes through a coarse screen into the "septic" tank. This tank is constructed in duplicate, each part being capable of retaining a twenty-four hours' flow of sewage. As a precautionary measure these tanks were covered in a substantial manner, and were provided with tall vertical ventilating shafts similar to those employed for the ventilation of sewers. This precaution has proved to be unnecessary, as far as the prevention of nuisance is concerned; but the protection thus afforded against wind and rain has been undoubtedly advantageous.

The roofs of these tanks may be identified in the accompanying illustrations (figs. 2, 3, 4) by their ventilating shafts. The tanks were formed by excavating the soil, and were then built in brick and rendered inside with cement. It was thought well to construct the tanks in duplicate in order to provide for accident or for the necessity of repair, and to allow a tank to be thrown out of work for the removal of sediment or "sludge"; the necessity for the removal of sludge, however, does not seem likely to arise, since the low-level tanks for receiving the "sludge" have not as yet been called into use. Both the inlets and the outlets of the tanks consist of elbow pipes, the ends of which are beneath the surface of the liquid within. The solid fæcal matter rises to the surface of the liquid, and the arrangement of the elbow pipes not only insures that this matter shall remain in the tank during its dissipation as gas and liquid, but also that it shall not be disturbed meanwhile by the flow of the liquid. It may be stated that advantage has been thus far obtained by the possession of duplicate tanks, since they have been worked singly and alternately, and a longer period for the disposal of the solid fæces by bacterial action has in this way been secured.

The effluent passes from the septic tank by an exit, which is indicated by the boy in fig. 3, and flows along an open channel on its way to the coke-beds. This channel is seen beside the tank and bed in the illustrations. It was constructed in a succession of steps, so that the liquid, by falling over weir-walls, might be freed from much of its dissolved gas and might become aërated. This aëration has since been more fully secured by letting the effluent fall through perforated trays before passing over the weirs.

From the culvert the liquid flows into a tank filled with small graded hard coke, known as "pan-breeze," which has been sifted free from dust. The liquid is distributed over the coke surface by flowing along branched "grips," which are excavated in the surface of the coke: these are well shown in fig. 4. The grips are lined with fine coke, which serves to filter off the coarser particles, and to prevent them from getting into the bed. This fine coke is raked off at intervals and replaced by similar fresh material. As soon as the coke-bed is full to the upper surface of the coke, the flowing liquid is diverted into another similar bed. The bed is then allowed to stand full for two hours, after which the liquid contents are allowed to

flow away through drainage arrangements provided on the floor of the tank. This liquid constitutes the purified sewage effluent.

The tanks for containing the coke are constructed in a similar way to the septic tank, but they are not covered in. They have square drainage channels provided in their floors, which are covered with perforated iron plates. Six of these coke-beds are provided, and they are used in succession, as has been indicated above. Three of them are filled and emptied each day, the liquid remaining in the bed for two hours, and the bed being allowed to stand with air in the interspaces of the coke after its liquid contents have been discharged. Two of the remaining beds have their inlets and outlets opened and receive the effluent from the septic tank passing continuously through them from 5.30 P.M. to 6.30 A.M., a period during which the flow is naturally very slow. This passage of effluent serves to maintain the proper bacterial condition of the coke while the bed is not doing duty.

Each coke-bed in this installation is doing very easy work, since it has been found possible in treating London sewage to fill a bed three times in twenty-four hours over long periods, and to obtain satisfactory results: the treatment has even been pushed to four fillings per twenty-four hours. It is well in any sewage plant to have some reserve beds, since a bed may occasionally require to rest for a day or two after being emptied, and it may also require to be laid up for repair.

Since the bacteria and other organisms which effect the purification of the sewage are derived from the sewage itself, and require some time for their full establishment in the septic tank and in the coke-beds, it is found that the amount of purification produced by a new plant increases for a considerable period, and that, so far from the tanks requiring renewal or cleansing, they become increasingly efficient as their age increases if they are worked with regularity and are left undisturbed.

As has been already stated, the purification has generally been attributed to various species of the simplest forms of vegetable organisms known as bacteria. Other organisms, however, undoubtedly contribute towards the result, and the process may therefore be more correctly termed the "natural" or "biological" treatment of sewage. No chemicals whatever are used during the treatment, and the process is identical with that which occurs in the treatment of sewage on the land in sewage farms. The biological plant, however, possesses the advantages that it causes no offence, and that it requires less space and is more satisfactorily under control than the sewage farm. It compares favourably with the chemical processes of treatment, which can never effect economically a purification equal in degree to that secured by biological action, and which produce a much larger amount of sediment or "sludge."

My acknowledgments are due to Dr. Fowler of Manchester, and to Mr. J. W. H. Biggs, for their cooperation in planning the scheme of treatment; to Messrs. Aston Webb and Ingress Bell, for furnishing a copy of the plans ultimately agreed upon; and to Mr. Charles E. Brown, science master at the school, for photographs of the plant in action.

DISCUSSION OF PROFESSOR CLOWES'S PAPER.

The President, Mr. Aston Webb, R.A., F.S.A., in the Chair.

Dr. GILBERT FOWLER, who rose at the instance of the President, said that he had a very small part in the initial stage of the installation at Horsham, and it was satisfactory to know that it was going on so well. There were a number of points he had thought of speaking about in connection with small installations which might perhaps be of interest to architects. First of all it occurred to him that architects were singularly fortunate people, in that for them, in large measure—it sounded paradoxical to say so—the sewage problem did not exist; for this reason, that the sewage problem had come to be pretty well a question of cost. There was no doubt that by modern methods it was possible to produce an effluent of any degree of purity up to potable water if necessary. He knew of an installation which was being considered now for a small town in the vicinity of St. Petersburg, where the Tsar was accustomed to go for his summer holidays, and where an outbreak of typhoid had made the inhabitants extremely anxious that the sewage should be efficiently purified. He understood that they contemplated there an installation something like that at Horsham, followed by sand filtration, and finally disinfection by ozone. Thus, when they were not tied by cost, they could do what they pleased. But, speaking more reasonably, there was no doubt that installations for country houses and comparatively small places, such as architects were frequently called in to deal with, might be made efficient without any serious question of cost arising; for this reason, that an addition of a few pounds to the cost of an installation might nearly double their factor of safety. It was well to have the largest factor of safety within limits that they could. Dr. Clowes had very properly emphasised certain limits that existed, more especially the size of the septic tank. There could be no doubt that it was possible to over-septicise sewage. The installation at Horsham was a case in point, and in the last report to hand from Massachusetts the Andover sewage tank, which had been reported on for several years there, had finally been put out of action, because it was definitely proved that sewage which had had a long, slow travel in the sewer, and finally a long sojourn in the septic tank, had become over-septicised, putrid fermentation had set in, and the sewage was more difficult to purify in consequence. He had a similar case under his own observation of a works which was laid down for a considerable district, and the sewage was admitted to the tanks when only a small portion of the district for which the work was constructed was actually coupled up; the whole of the tanks were filled, the reason being that there was some apprehension, he believed, as to whether the walls in their green state would stand, and consequently the flow through the whole set of tanks was very slow, and there was a really terrible nuisance; and that was undoubtedly because the sewage was passing too slowly through the tanks, and there was in consequence a development of sulphuretted hydrogen. So there was a limit to the size of the septic tank, and it was possible, though not so likely, there might be some limit to the size of the beds. They had had a case—in Manchester, where they had only started a bed a few months—when owing to the construction works they had to stop it for several weeks, and they found it was practically a new bed when they started again. But he did not think that would have occurred in the ordinary way, if the bed had had time thoroughly to mature—but that was a moot point. Anyhow, it was well to have a good margin, as was the case at Horsham, where they needed only to fill the beds perhaps once a day. A case had come under his notice that might be of interest in regard to a country house, when he was asked in a friendly way to look through the plans, and he took care that there was this factor of safety. He wrote recently to the owner of the house to ask how he had got on—he had had three years' experience—and he said the effluent all through that time had passed into a little pond by a well-frequented roadway, and there had been no complaint whatever. The only difficulty he had had was that a certain amount of the scum had got into the exit pipe of the tank, but that they had readily met that. This gentleman had written to him (Dr. Fowler) in great distress once, thinking his tank had completely filled up with solid matter, and he (Dr. Fowler) suggested what had happened, which was also the case with Horsham, that most of the solids had floated up to the top and constituted a scum in which a considerable amount of very vigorous bacterial action was going on. He investigated it a little more thoroughly, and found that was the case. Immediately this leathery coating was pierced the water was underneath. He took out the excess of scum, threw it about on his lawn, and it all disappeared. That was practically all that had to be done to that tank, or cesspool as they would have called it in old days, for three years, and the effluent from that tank passed on to one of two cinder beds; they were only a few cubic yards in size altogether. In this case, as it would involve a certain amount of complication, it seemed better that the tank effluent

should be allowed to trickle continuously through, and this was done with an ordinary little perforated zinc tray. All that was done was that every day the gardener went down and turned the flow from one side to the other, and, having allowed a plentiful margin of cubic space in proportion to the amount to be dealt with, there was no difficulty in the purification. The whole difficulty came in when, as in the case of a great city like Manchester, they had to get the utmost out of every cubic yard of space—then they had to consider very carefully questions of cost right through. But little difficulties of distribution, or anything of that sort, were all neutralised if they had a plentiful margin of safety, and in most cases it could be readily allowed for in small installations at a comparatively insignificant cost. But, of course, while in the case of a country house an extra five-pound note might add 25 per cent. to the whole installation—if they came to work that out in a big town, it ran into hundreds of thousands, and that was where the difference came in. The cost of installations generally, of course, varied according to conditions. Whether they should have intermittent methods or continuous methods was very largely a question of condition, the fall available, and so forth. He believed, especially where they could have this margin, that the very simplest methods were always the best; that they could get quite as efficient results by some simple method of distribution, for instance, allowing, as Dr. Clowes had described, the sewage to just percolate through these grips, or through a certain amount of fine material through the surface, as had been done at Friern Barnet for years. Methods of that sort gave quite as good results, and were liable possibly to less accidental interference than more complicated mechanism. That was his own feeling, and that had been the conclusion come to by Professor Dunbar, of the Hygienic Institute, Hamburg, who had done some of the best Continental work on the subject, and with whom he had had a great deal of correspondence. The form of filter Dr. Dunbar recommended for small installations was made by about six to nine inches of fine material on the top, with rough coarse material underneath. The fine material gave two things: it gave distribution, and gave also what had come to be known as absorption—that is, an action of those beds which was not often referred to in English literature on the subject, but was undoubtedly of great importance. There was no doubt that the physical effect of the medium was of great importance, and that was why the question of the size of the medium had always to be considered. It was possible, by taking absolutely sterile clinkers of a certain size, and passing sewage through, to get a very considerable purification. Dyes and so on would be taken right out of solution by the purely physical absorption, and in the same way matters like peptone and albumen, and so on, nitrogenous matters akin to those which occurred in sewage, were taken out wholly by the absorptive action of the medium. That very soon ceased unless a biological action succeeded, and then the absorbed matter was oxidised by the action of the bacteria, and there was also apparently a purely chemical oxidisation—which was brought about by these beds owing to the physical attraction of the moist medium for oxygen. Professor Armstrong would be interested to know that it was possible by means of these beds to oxidise di-methyl aniline to methyl-violet, a reaction which in a laboratory required rather vigorous oxidising agents. If di-methyl aniline was put on the medium in good condition it was instantaneously oxidised to methyl-violet. He had been told that there were cases in Hamburg where they found this oxidation effect was of great importance in connection with the treatment of isolation hospitals, and he thought it would be a point of interest to this meeting. A difficulty often arose as to what was to be done with sewage which was specifically infected, say by typhoid from a typhoid fever hospital or any other infectious diseases hospital. Of course, the mere passing through these beds, it had been abundantly proved, was no real safeguard as regarded the removal of pathogenic organisms; but it had been found that it was possible to sterilise absolutely such sewage before putting it on to the bed by means of chloride of lime, and after such sterilisation it would be put on to a filter bed, more especially a percolating and thoroughly oxidising bed, and the chloride of lime was oxidised to chlorate, and the purification went on, if possible, more vigorously than without the presence of the chloride of lime. But sterilising agents such as carbolic acid would inhibit the oxidising and purifying effects of the bed. If chloride of lime was used it was possible, according to the Hamburg experiments, to sterilise the sewage and free it from pathogenic germs before putting it on the percolating filter or contact beds. For such work they preferred this simple form of percolating bed he was describing: first of all, a fine layer which served as an absorption layer, which arrested the finely suspended matters, and also a large proportion of matters in emulsion, as one might say, and then the liquid passing from that percolated through the coarse material and became thoroughly oxidised. He was told by Dr. Dunbar that about 50 per cent. of this change took place in this top six inches, and he believed the right use of the fine material on the top would help in many cases towards a very simple solution of very small sewage problems. He knew a little works at Clifton Junction, near Manchester, which was made by a sand top and coarse material underneath, which had been going with excellent results for twelve years, with just occasional scraping of the sand—that was all

that had been required; and such a method as that seemed to be excellently suited for small installations. In Manchester they had these grips on the top of the beds, and they removed quite a large amount of sludge from them from time to time, which was simply tipped as earth, and caused no nuisance at all, and the labour involved was not very excessive. He had had some costs got out—they had been very carefully going into the costs all the time—and up to the present time for the whole year they tallied very well, the last half-year with the last quarter. It came out at about 3*s.* a million gallons. Such figures of course were only of use if used judiciously. What could be done in a huge town with millions of gallons could not be done—the cost must go up *pro rata* very much—with a small installation. Still, the labour involved in occasional scraping of beds in either a small or a large installation was not at all excessive. The cost of construction varied according to the necessities of the case. Their little septic installation in Manchester, an experimental installation of about 20,000 gallons, cost them all through, with automatic gear and everything, something under £600; but he had heard of installations costing a good deal more. It all depended upon how the thing was done, on a variety of local conditions which always had to be taken into account. Should any questions arise in the discussion which he could throw any light upon, he should be pleased to do so.

MR. HAROLD GRIFFITHS congratulated the Institute upon having so practical a Paper of such importance to architects read to them that evening. It might be thought by some architects of eminence that the disposal of sewage was quite beneath their dignity; but to those he ventured to point out that in his opinion every channel and artery necessary to complete and perfect the structure came within the scope and duties of the architect. No doubt sewage disposal which met the case very well thirty years ago was now quite out of date; for at that period, so long as the sewage was not in view, everyone appeared satisfied—but at the present time nothing less than a scientific disposal of sewage, such as described by Dr. Clowes, would suffice. There were one or two points on which he would like to have some little additional information. He was at present laying down a sewage scheme, exactly as had been described that evening, for a Surrey mansion, and the difficulty he had was that when the family were in occupation there was a considerable amount of sewage, but when only the staff were there there was only a tenth of that sewage—which made it somewhat difficult to proportion his septic tank and bacterial beds. As regards cost, the house had approximately seventy rooms, and housed about sixty people, and he was laying down such an installation, including the connections from the existing pipes, at a cost of about £150, including the disposal of the effluent by perforated pipes entirely under the surface of the park land. It was a small system, but it was a small amount of money also. Would Dr. Clowes kindly tell them how long the sewage should remain in the septic tank before it flowed on to the bacterial or filter chamber? It had been stated that if it remained too long it became inert, and there must be a time when they could run it on the bacterial chamber before the proper chemical action had taken place in the septic tank. Coke had been mentioned as the best filling material. He should like to ask whether ballast was not as good. As to the size of the filling material, he had heard with some astonishment from Dr. Fowler that coarse sand on the top of the filling was a great advantage. It would be useful to have it stated that they could use sand with coarser filling material underneath for a certain number of inches, and it would be of great practical advantage to those present if the proportions and exact size of the filling material could be given. He should like to ask whether the process could be repeated twice in one day, and, if so, what interval should elapse between the irrigations; also, where there was little sewage for disposal, how many days they could go from one irrigation to another without destroying the bacteria in the chamber; again, what became of the grease from the washing up. In his scheme, which received the washings from the dairy vessels, it was proposed to run the grease into the septic chamber in the ordinary way, and he wanted to know whether it would be purified, or be likely to clog the filling material in the bacterial chamber. He understood that at Horsham they had thought proper to keep out the washings from the laundry, which would contain soapy and greasy matter. For a small scheme he would suggest that a perforated trough of oak would be much better for distributing the sewage over the bacterial chamber than the method adopted at Horsham. They might cut trenches, but it appeared to him that the sewage would immediately begin to sink down at the end of the chamber nearest the outfall, and would not reach the other end of the chamber except by coming up from underneath; whereas, if a perforated trough were adopted, it would distribute the sewage all over the bacterial chamber. He should also like to ask whether two hours was the proper time for the sewage to remain at rest in the bacterial chamber. He had always understood four hours; if he was incorrect he should like to be put right on that point.

MR. F. J. WILLIS, Secretary of the Royal Commission on Sewage Disposal, said he had been very interested in the paper. It was through the work of Dr. Clowes and others like him that the Sewage Commission were getting their experience.

MR. R. LANGTON COLE [*F.*] asked whether in an installation on a small scale, for an ordinary

country house, it was desirable or not to go in for one or other of the automatic processes in use. Then, as regards stagnation, what was the best method of getting over that difficulty, when a house was only occupied for a portion of the year? Was it safe to leave the ordinary beds with automatic arrangements to themselves, or should some special arrangement be made for dealing with the reduced flow?

MR. E. PENFOLD [*A.*] said he was preparing a scheme of sewage disposal for a small isolation hospital where they proposed to have the automatic system, not the intermittent. He was surprised to hear from Dr. Fowler about its being rather doubtful whether the effluent would be safe. He should like to know how Dr. Fowler proposed the application of chloride of lime before the sewage passed into the septic tank.

DR. ARMSTRONG, F.R.S., said that both the President and himself must greet Dr. Clowes's appearance there that evening with considerable satisfaction, inasmuch as they were primarily responsible for the suggestion that this system should be adopted at Horsham. As one of the governors of the school, he had had to consider very carefully the problem of disposing of the sewage. It was a difficult problem to face. Personally, however, after various visits to the outfall under Dr. Clowes's superintendence and guidance, he had very little doubt as to the desirability of adopting the scheme; but, although he had never before ventured to hint at such a thing, he thought the President was a trifle nervous at times; and, therefore, it must be a great satisfaction to Mr. Webb to know that the scheme did operate with such absolute success—for he believed that was the result of their eighteen months' experience with the system. Dr. Clowes had done everything he possibly could to assist them in this matter. He was sure the President would agree that the present was a proper opportunity on which to tender him their most grateful thanks for the assistance he had always so willingly rendered. From a scientific point of view this system of sewage disposal was one of extraordinary interest. In the first place, it was a justification of the old cesspool system. The cesspool had been got rid of; it was thought to be an abomination; but they were coming back to the cesspool, only on a larger scale, with the precaution not to draw immediately on the tank for their water supply! That was really the only distinction between the modern and the old system. In the old system the well and the cesspool were put side by side; they were now very careful to avoid having the well near the cesspool, although, perhaps, as Dr. Fowler had foreshadowed, they might even be prepared later on to drink sewage which had been properly dealt with by this system! When one considered what was going on in these tanks, the process would be seen to be altogether extraordinary. The paper, he thought, illustrated first of all the difficulties under which the architect laboured in these times when he was called upon to be a master of all trades; and in the second place, it emphasised the importance of the architect receiving a thorough grounding in scientific method, and a thorough training in scientific knowledge.

MR. OSBORNE SMITH [*F.*], in seconding the vote of thanks, said he should be extremely grateful to Dr. Clowes if he would tell them a little more about how the laundry refuse was got rid of from the washing for a thousand boys. He should like to know if it was turned on to the beds with the rest of the sewage, or whether it was treated separately. This was a serious difficulty, which was encountered by all who had to deal with houses in the country. There was another difficulty: at times the beds had to be put in such a position that they had to be covered, and he would like to know the exact effect of that. In some cases he believed it had a disastrous effect, and if that was the case he should like to know how it could best be met.

MR. E. VINCENT KING [*A.*] asked a question about ventilation. He had been connected, he said, with a system up in the North which was carried out in quite a similar way at two infectious hospitals, but they had not ventilated their tanks. There was only a space of about four inches between the top crust and the under side of the cover of the tanks. They understood that in that crust the microbes were a kind of cannibals that they ate one another when in so doing they got rid of the solid matter, and that ventilating the tank would destroy this action.

MR. MAX CLARKE [*A.*], in supporting the vote of thanks, said that he had put up a small bacteria tank in 1893, but unfortunately at that time he did not know anything about the secondary or coke beds, so allowed the effluent to run from the tank along a trench cut in the ground, and that had been going on with very successful results. The installation was for a small house with accommodation for about six persons. He was discussing the details of this installation with a man last year who told him that he had just come from inspecting a very large installation of this nature for a public institution, and he said that the scum had grown right up through the drains and the soil pipe with such disastrous results that the whole system was blocked up. He had been unable since to find out anything more relating to this particular catastrophe, but he would like to know whether anything of the kind had come under the notice of Professor Clowes or Dr. Fowler.

A MEMBER asked what would be done in the case of a perfectly level site where they could not get a fall.

MR. FRANK LISHMAN [*A.*] asked what effect

a severe and prolonged frost would have on the system.

THE PRESIDENT said he quite agreed with Mr. Griffiths that architects should keep up with the science of the disposal of sewage as much as with any other part of their intricate and elaborate work. It was partly owing to Dr. Armstrong's suggestion that this principle of sewage disposal was finally adopted at Horsham; it was also at his suggestion that they were fortunate enough to get the help of Dr. Clowes in carrying it out; and it was at Dr. Clowes's suggestion that they were fortunate enough to have further help from Dr. Fowler. They were under great obligations to these three gentlemen in this particular matter; and although he felt he must apologise for a second evening being devoted to this particular school, still, when he found that Dr. Clowes was willing to give them a description of the work done there in sewage disposal, he thought he should not be doing the Institute a good turn if he did not encourage him in his kind willingness. They had rather a difficult task at Horsham, because the nature of the land there was not suitable for the disposal of the sewage over the land, though Horsham itself had tried that principle—in fact, it had a sewage farm not very far off. It was a first essential that any effluent which passed from the school buildings, which had over a thousand occupants, should be as pure as it possibly could be. It was a test of its success that for eighteen months that effluent had been passing away without any complaint, or any cause of complaint, from anybody who resided in the district. Before this work was started Dr. Clowes had been kind enough to take him down the river on a beautiful sunny day. They spent a long time at Barking, and certainly the effluent he saw there pouring in its tons into the Thames was a very different effluent from that discharged from the sewage treated on the method under discussion. Some time ago he had the advantage of hearing Dr. Clowes on a similar subject at the Royal Institution, when he said that these bacteria could be subjected to an extraordinary amount of heat without their vitality being affected in any way, but that when they were exposed to the rays of the sun they turned up their feet and died at once! That had always struck him as a wonderful example of the great healing and beneficent effect of the sun's rays. And that was one of the principles they had acted on at Horsham; to call in the sun in every possible way to preserve the health and strength of the boys who lived there. With regard to private installations, which, as Dr. Fowler said, must come so often under the notice of architects, he had found exactly the difficulty mentioned by another speaker, namely, the difficulty of the unequal flow through these small installations. In one house he had an automatic system which was supposed to throw the matter first on to one bed, and when that bed was full on to another, and so on, and it worked very well up to a certain point; but when the house was full of visitors, and there was an extra number of baths or an extra amount of water used, the automatic system failed altogether. Whether that could be improved or not he did not know, but it was certainly one of the things they must look to these gentlemen to for assistance. Before putting the vote of thanks, he should like to say how very much indebted architects must always be to the scientific men who took an interest in these things. Architects did not profess to be experts in such matters; they must call in, and every wise architect would call in, men who were experts to advise them before they adopted measures at the expense of their clients, which was a very serious thing. Therefore it was that they were so much obliged when these gentlemen came amongst them and explained these matters to them.—In putting the vote of thanks the President said he was sure the Institute would wish to include in the vote Dr. Fowler and Dr. Armstrong.

DR. FOWLER, asked by Dr. Clowes if he would give shortly his experience with regard to automatic arrangements, said it was a somewhat delicate question on which to speak publicly, because there were a great number of these automatic apparatus, each one of which had some special feature; so that his remarks would be of a general character. The economic use of the automatic gear depended, he thought, upon the amount of labour that could be saved. If they could save practically all labour, and dispense with the men entirely, then they saved 100 per cent. on labour; but if their installation got bigger and bigger, and they were bound to have a number of men about, then the apparent use of the automatic gear became less and less. He personally had at one time, and still had, a great wish to see everything done as cheaply as possible by machinery; but when it was found that quite a large area of beds could be controlled by one man, the game seemed hardly worth the candle; and it came to this, that the question was not really a question of the area to be controlled, but of the flow to be controlled at a given moment. There might be, as there was, for instance, at Manchester, altogether seventy-two acres to look after; but there were only 1,000,000 gallons per hour to look after, and one man or two men could very easily distribute that amount of water round the works by means of sluices. It was not as if the whole twenty-six or thirty million gallons came down at once. He remembered, in the early stages of the Manchester scheme, they were told they would want about a thousand men rushing about opening and shutting sluices for their lives! But that was not the case at all, for the reason that only a certain limited amount of water came down at a

given time. If all the beds were supplied with expensive machinery, a very large proportion of the plant would simply be lying idle the greater part of the time. But in all these cases the economic mean had to be found, and he was sure that any automatic gear adopted must be of the very simplest. It was possible to devise extremely ingenious and highly intricate arrangements of siphons and tubes and what not, which would act extremely well if one had clear water, and were only concerned with putting clear water from one tank into another. But sewage was a different thing. Not only did it contain matters in suspension, but, what was of even more importance, it produced a growth in pipes through which it flowed without access of air. Any one without experience would hardly realise what it could amount to. He had seen a pipe about three inches in diameter through which an uninterrupted flow of effluent passed which had become completely blocked with a liver-like mass of sewage fungus; and in a smaller degree all pipes through which sewage flowed without access of air were liable to these growths of various organisms with long names which he was not altogether familiar with, except in bulk.

THE PRESIDENT: That accounts for the case mentioned by Mr. Max Clarke, I suppose.

DR. FOWLER: That, I take it, was a case similar to the one I have mentioned, where the actual scum in the tank grew to such a point that it blocked up the outfall. It was quite conceivable for it to go up the soil-pipe. For want of air they got an actual growth. On the sill of the septic tank would be seen long fronds of this fungus that would grow. Any automatic gear adopted should be free from small pipes, or anything which could get out of order; it should be something of the very simplest—a mere tipping bucket, or something of that kind.

DR. CLOWES, answering other questions put during the discussion, said he was asked how he proposed to provide for the state of things in the absence of the family altogether from the mansion, when the sewage was reduced to a very small amount compared with that which usually passed. He had mentioned in his paper that at Horsham they were at first very much troubled by the fact that the flow almost ceased in the first year during the Coronation holiday, and that they were only able to meet the case by turning some of the water supply through the whole system. The flow was trivial compared with what they usually had, and they found it absolutely necessary to supplement it. That was the only way they could suggest its being dealt with. Dr. Fowler, he thought, was suggesting something else.

DR. FOWLER: I was only thinking whether, in cases where there was great variation in the course of the day, it was possible to allow the sewage to pond up to some extent in the tank, and let it flow away afterwards by some arrangement of the ball-tap type. I think I suggested something of the kind in that little country-house installation I was speaking of.

DR. CLOWES: Then a question arose as to the length of time which the sewage should remain in the septic tank. He believed Dr. Fowler would agree that it was unwise to allow the sewage to take longer in its passage through the tank than twenty-four hours; very shortly after that it began to undergo the foul putrefactive change which he referred to, and it would then certainly lead to the tank becoming a nuisance. They had had septic tanks at work for many years in experimental installations at two of the London sewage outfalls, where they had given only six or seven hours for the passage of the sewage through the tanks; but, of course, London sewage was in a different condition from the sewage of these isolated buildings, since it had been many hours on its passage to the outfall, which was far distant from the town, and therefore it had already undergone a certain amount of this septic change; but generally more than twenty-four hours was highly undesirable. As regarded material for filling the bed they found nothing was quite so efficient as coke. Ballast had been used successfully; hard clinker from boiler furnaces, broken brick, and the broken "saggers" or rough clay vessels in which potters burnt their ware had been also very successfully used, but none of them gave quite as good a result as coke. With regard to the spacing of the two fillings per twenty four hours, ideally, of course, those two fillings should be separated as widely as possible; but, as a matter of convenience, it was generally found that they took place during the daytime, because it was not economical to have a man kept late in the night in order to place the second filling at its proper time. With regard to the necessity of feeding the bacteria at regular intervals, it was not absolutely necessary to supply them frequently with nourishment. For long periods, say, either a week or a fortnight, the passage of drinking water through these beds seemed to maintain them in condition; that is to say, they began their efficient action directly the sewage came in after they had been supplied in this way with water. Possibly the bacterial organisms themselves survived, as there was probably a sufficient remnant of sewage matter in the bed to maintain them; he should think it was likely that in that case the spores also came into action after a time. The grease would disappear entirely in the septic tank—that is, it would rise with the other solid matter that formed the scum, and in that scum it would be dealt with efficiently by the bacteria; and, as was stated in the paper, it would even aid the bacterial action by the alkali of the soap, the ordinary form in which the grease was introduced. The greasy soapy matter from the laundry at

Horsham was separately dealt with, he believed, by passing the water through vessels filled with common flints; the soapy matter apparently adhered to the surface of the flints, and was ultimately removed by bacterial action. The liquid which passed away, freed from soap, did not go through the installation for treating the sewage, but flowed away separately.

THE PRESIDENT: The level does not allow of it.

DR. CLOWES: A speaker had suggested that a perforated oak trough might be better than grips, for distributing the sewage over the coke-beds, because the grips would not carry the liquid throughout the length of the bed. Of course, the proper distribution of the liquid by the grips depended upon the surface of the grip being covered with sufficiently fine material, and with a sufficient quantity of it. As a matter of fact, they had easily arrived at a system of working by which the liquid was sufficiently checked in its passage into the beds to ensure its even spreading over the grips. He had spoken of two hours as being allowed for aëration of the beds as the minimum interval between the times of filling. Two hours appeared to be quite sufficient, but there was no objection to that period being extended, as it often was, to ten or twelve hours or more.

MR. GRIFFITHS said he had asked whether the liquid should remain in the bacterial beds two hours or more.

DR. CLOWES replied that there was no doubt the main part of the purification was carried out in the first half-hour; more than 50 per cent. of the purification in their experience was effected in quite the earliest stages; but they generally gave about two or three hours, because a certain amount of purification went on during that interval; but after that there was practically no advantage obtained by prolonging the contact. He had been asked how they should arrange covered beds where covered beds would be necessary. He did not know for what reason they would be necessary.

MR. OSBORNE SMITH: Supposing the site was so limited that the occupants of the house would be annoyed by the smell of the beds?

DR. CLOWES: But these beds do not smell; neither the septic tanks nor the beds smell. If there were any question of hiding them, there could be no objection to a loose cover open freely at the edges. The coke beds must have aëration, and must not be shut off from the free access and circulation of air.

MR. OSBORNE SMITH: Must they not be shut off from the sun?

DR. CLOWES: It had been suggested that the sun would stop the action, because it was inimical to bacterial life; but the bed is completely opaque to light, and the sun did not penetrate the bed: any effect of sunlight was entirely superficial. Dr. Fowler had referred to the scum stopping the outlet. He believed the scum might do it as well as the fungus growth he referred to; but Dr. Fowler mentioned himself that, in case the scum did actually stop it, it could be simply mechanically removed. They had never had a case of a pipe being choked with scum. At Horsham it might conceivably have happened, because the scum became very thick when they ran one tank for a long period; but the man was told to probe the scum, and ascertain its thickness, and, if it was getting anywhere near the entrance or exit of the shoulder pipe, to at once turn off the sewage supply from that tank and to allow the sewage to flow into the other one; and in that way they had never had any trouble from scum entering the inflow or outflow pipe. When an absolutely level site had to be used, pumping must be resorted to. He was afraid there was no way out of it; they could not break through the laws of nature with regard to gravitation. Frost was really not troublesome, in the sense that one speaker seemed to suspect. A sewage farm was, of course, frequently thrown entirely out of action by a severe or long-continued frost, since the soil became frozen solid, and no purification went on. But he did not think that anyone with experience of these beds had ever seen frozen beds; they had always been used throughout severe winters. Although there had been no very severe frosts lately, he remembered, during a severe winter at Bristol, looking at some beds which had a thin skin of ice over the surface, but everything was going on in a perfectly regular and normal way; the ice did not extend to the filling point, for the simple reason that sewage liquid has a temperature considerably above freezing point. The temperature of London sewage was never below 56° F., and he should doubt if liquid carried by underground pipes could ever fall to anywhere near freezing point; so that there was constantly a comparatively warm liquid coming into the bed, and the mass of the bed was kept entirely open.

MR. E. B. PIKE: As chemist in charge at the northern outfall for the London sewage, may I say that one winter the large acre coke-bed was covered with a thin sheet of ice for several weeks, and the only effect noticeable was a slight lowering in the quantity of nitrates produced during the purification, which proceeded uninterruptedly and satisfactorily?

DR. CLOWES, continuing, said he believed it never had occurred in any case that the bed had been blocked. It might be useful to state that the London sewage occasionally contained much salt water, and that this had not been found to be in any way prejudicial to the process of biological treatment. Direct experiments had also been made with the object of comparing the facility with which the purifying bacteria lived and multiplied in sea-water and in fresh water. No differ-

ence was noticeable, and it may be assumed therefore that sea-water is in no way prejudicial to the treatment. The President had been good enough to thank him and Dr. Fowler for the part they had taken in connection with this matter; but, personally, he was glad to have had an opportunity of putting up a small plant which he could further watch, as, after working for some years at the London outfalls, the results arrived at were final, and the treatment had passed the experimental stage. He should like rather to thank Dr. Armstrong and Mr. Webb for the opportunity which they had given him of having a small plant which he could continually observe, and from which he could still learn many useful lessons.

MR. D. J. EBBETTS, Engineer to the Acton Urban District Council, who had received an advance proof of Dr. Clowes's Paper, sends the following notes:—

In my opinion, the treatment of drainage from isolated buildings in the country should commence with a septic tank. I do not see any need, in such cases, to make the septic tank in duplicate, but I should construct two small detritus tanks—only one of them, of course, being used at a time; and from the detritus tank grit, sand, &c. &c., could readily be removed when the necessity arises. I think it quite unnecessary to cover in such septic tanks, and would point out that it is not always necessary to construct expensive walls and floors to form the septic tank. It depends, of course, upon the level of the tank in regard to the ground, and on the nature of the soil. For instance, in a chalk soil, excavation can be made and its side and bottom can be cemented, forming a very suitable tank; or if the soil is clay, or even a stiff soil where clay can readily be obtained, the excavation can be made in the earth and lined with puddled clay.

As to the effluent from the septic tank, I hold that there are three ways at least in which it can be treated satisfactorily:—

(1) *By broad irrigation.*—Where a small farm is carried on in connection with an isolated country house, this system can very well be adopted—supposing that intelligent management and direction is available. In such a case, it seems to me that this is the best and most satisfactory means for the disposal of the tank effluent.

(2) The tank effluent can be taken in a small underground chamber with an automatic siphon discharging its contents into a network of unglazed pipes below the level of the grass. This is a very admirable way of disposal, it is quite out of sight, and practically requires no attention at all. The automatic siphon may be expected to last a great number of years with absolutely no attention, although, as a matter of precaution, it should be inspected from time to time.

(3) The effluent from the tank may be taken to a filter. For my part I hold that the filter should be an aërobic filter. It seems to me that it is a more scientific and successful way of treating the effluent, and if one looks at the opinions expressed by those who have experimented for a long time with such filters, I think one can only arrive at the conclusion that aërobic filters are destined in a short time to take the place of the contact filters which are in many places now in use.

The Royal Commission on Sewage Disposal will no doubt settle this point for us, and if we only live long enough, we shall some day be able to read their report.

One of the advantages of the aërobic filter is its very low cost. I cannot understand Professor Frank Clowes's statement that the plan for continuous treatment (aërobic filter) would probably be in most cases more than that for intermittent.

The aërobic filter is far smaller in size, and for this and other reasons is much less costly to instal, and requires less attention when installed, while there certainly is no difficulty in times of frost.

The contact filter which Professor Clowes refers to is a watertight tank, which has to be constructed and filled with a filtering material, with special drainage channels at the bottom, &c.

The aërobic filter simply consists of a heap of filtering material freely exposed to the air, which may be of any shape or size. It can be shot down on the ground if the levels of the adjoining surface allow of its being so placed, or an excavation can be made in the ground, and the heap can be piled up in the centre of the excavation. The bottom surface of the excavation should of course be made with slopes, so as to throw off the water; but no special underdrainage arrangements are required.

Much expense is often gone to in providing patent distributors to supply the tank effluent to the aërobic filter, but I do not find any necessity for an expensive arrangement of this kind. Very simple troughs for feeding the liquid are all that is required.

Generally, I would point out that it is not necessary to go to any great expense in carrying out such works. Very often tanks and filters which are in use in such works are of a much more costly nature than in my opinion there is any need for.

9, Conduit Street, London, W., 20*th Feb.* 1904.

CHRONICLE.

L.C.C. By-laws relating to the Deposit of Plans &c. with respect to Drainage Work.

The Council have had under their consideration the two letters printed below, and desire to inform members that they endorse the views therein expressed. A letter embodying these views is being sent to the Local Government Board, the London County Council, and all the Metropolitan Borough Councils.

4, *Queen Square, W.C., 16th November* 1903.

To the Editor of the Journal of the Royal Institute of British Architects,—

Dear Sir,—In August 1899 the Metropolis Management Acts Amendment (By-laws) Act was passed (62 & 63 Victoria, chapter 15) giving the London County Council power to make by-laws with regard to the deposit of plans, sections, and particulars of certain drainage work, a portion of section 2 of this Act being as follows: "Requiring persons about to construct, reconstruct, or alter the pipes, drains, or other means of communicating with sewers, or the traps or apparatus connected therewith, to deposit with the Sanitary Authority of the district such plans, sections, and particulars of the proposed construction, reconstruction, or alteration as may be necessary for the purpose of ascertaining whether such construction, reconstruction, or alteration is in accordance with the statutory provisions relative thereto and with the by-laws made under the said section."

These by-laws have now been made, were approved by the Local Government Board 20th August last, and are in force at the present time. I enclose a copy herewith, as I think they are of such importance to architects practising in the Metropolis that they should be published in the Institute Journal, with some notes calling the attention of members to what they will be expected to provide in the way of plans and particulars of the proposed work. At the present time the remuneration of architects for this class of work is limited, many persons considering the Institute scale of fees should apply.

If it is the case that architects must, before having sanitary work approved by a sanitary authority, submit plans in duplicate showing "every floor of any building in connection with which such pipes or drains are to be used, and the position, form, levels, and arrangement of the several parts of such building, including the roof thereof, and the size and position of every drain, manhole, gully, soil pipe, waste pipe, ventilating pipe and rain-water pipe, and of any drain passing under such building, and the position of every bath, water-closet apparatus, slop sink, urinal, lavatory basin or apparatus, sink (not being a slop sink), and trap in connection with the foregoing" (clause 2); and also "show thereon the position of all windows and other openings into the building, and the height and position of all chimneys belonging to the building within a distance of twenty feet from the open end of a soil pipe and ventilating pipe" (clause 3), and also a block plan showing the properties and streets adjoining—if this be the case, it seems to me a complete set of drawings of the buildings will in all probability be required, or at any rate can be insisted upon.

I think it should be made clear to our clients that the above work cannot be done for the usual fees, and also that it has been required by the powers that be without reference to architects at all.

I also consider that the Institute should enter into communication with the various "sanitary authorities" for the purpose of ascertaining what construction they put upon these by-laws.

It has already been suggested that the authorities should not accept sun prints for these documents, which seems an unnecessary restriction, as sun prints on linen are, as far as we know, indelible enough for all practical purposes.

One point in connection with these new by-laws it seems to me should be settled by the Institute without delay—viz., do these by-laws, and the various drawings required by them, come within the clause in the R.I.B.A. Form of Contract which requires the contractor to give all notices and pay all fees, as the words "Acts, regulations, or by-laws" are used in the clause; or is it open to the architect to insert in the specification that the contractor shall include the sum of £ to cover the cost of copies of specification and drawings to be paid to the architect's instructions?

It is the case that regulations are in force in New York and other great cities similar to those in question, but I am not aware that they are so far-reaching in their requirements or involve such an amount of labour or expense as these might do in the hands of an irresponsible authority.

All the above points seem worthy of the immediate consideration of the Institute or its Council, with the object of making clear the duties of architects to their clients; the latter will, no doubt, be under the unpleasant necessity of paying a greatly increased sum, required in carrying

out these by-laws, whether it be to the architect or contractor.

If it is made quite clear who is to bear the cost, the less friction there will be on the subject, and the better will be the relation between the parties. —I am, Sir, yours faithfully,

MAX CLARKE.

The by-laws referred to are as follows :—

Construction of a drainage system as a whole.

1. (1) Every person who, in the provision of a drainage system as a whole, is about to construct the pipes, drains, or other means of communicating with a sewer, or the traps and apparatus connected therewith, shall deposit in duplicate with the sanitary authority of the district, at their office, such plans, sections, and particulars of the proposed construction as may be necessary for the purpose of enabling such authority to ascertain whether such construction is in accordance with the statutory provisions relative thereto, and with the by-laws made under section 202 of the Metropolis Management Act 1855.

(2) He shall cause such duplicate plans and sections to be clearly and indelibly made on a durable material to a scale (except in the case of block plans) of not less than one inch to every sixteen feet, and shall, amongst other things, show thereon every floor of any building in connection with which such pipes or drains are to be used, and the position, form, levels and arrangement of the several parts of such building, including the roof thereof, and the size and position of every drain, man-hole, gully, soil pipe, waste pipe, ventilating pipe, and rain-water pipe, and of any drain passing under such building, and the position of every bath, water-closet apparatus, slop-sink, urinal, lavatory basin or apparatus, sink (not being a slop-sink), and trap in connection with the foregoing.

(3) He shall also show thereon the positions of all windows and other openings into the building, and the height and position of all chimneys belonging to the building within a distance of twenty feet from the open end of a soil pipe or ventilating pipe.

(4) He shall at the same time deposit in duplicate with the sanitary authority of the district, at their office, a detailed description in writing of the intended mode of constructing, jointing and fixing any such drain, man-hole, gully, pipe, bath, water-closet apparatus, sink, urinal, lavatory basin or apparatus, or trap.

(5) He shall at the same time deposit in duplicate with the sanitary authority of the district, at their office, a block plan of the premises upon which any such building is to be situated, or any such work is to be carried out (drawn to a scale of not less than one inch to every twenty-two feet), and he shall show thereon—

(*a*) The block plan of such building.

(*b*) The position of the whole of the buildings on the premises, and so much of the properties adjoining thereto as may be affected by the proposed work.

(*c*) The names of the streets or thoroughfares immediately adjoining the premises, and the number or designation of the premises.

(*d*) The difference of the level between the lowest floor of such building and the adjoining pavement.

(*e*) The level of any yard, area, or ground, or open space belonging to such premises.

(*f*) The lines, size, depth and inclination of the proposed drainage, and, so far as can be ascertained without opening the ground, the lines, size, depth, and inclination of the existing drainage, the surface drains (if any), and, if such proposed or existing drainage be in connection with a building, the arrangements for the ventilation of the drains —the existing pipes and drains and the proposed pipes and drains to be distinctively indicated by different colours.

(*g*) The position and form of every existing or proposed manhole or access chamber, gully, junction, bend, intercepting trap, or any connection with a sewer.

(*h*) The points of the compass.

Provided, nevertheless, that it shall not be necessary to deposit a block plan in any case where the plans, sections and particulars deposited in accordance with the first paragraph of this by-law clearly show the particulars hereinbefore required to be shown on a block plan.

(6) The plans, sections, particulars and detailed descriptions hereinbefore mentioned shall be so deposited fifteen days at least before the work is proposed to be commenced, and, in the case where a building is to be erected, before commencing the erection of such building.

Addition to, partial construction, entire or partial reconstruction, or alteration of, a drainage system.

2. Every person who shall make any addition to, partially construct, entirely or partially reconstruct, or alter any pipes, drains, or other means of communicating with a sewer, or the traps and apparatus connected therewith, shall be deemed to have satisfied the foregoing by-law No. 1, if he shall cause a deposit to be made (in the manner therein provided) of only such plans, sections, and particulars of the proposed addition, partial construction, entire or partial reconstruction, or alteration as may be necessary for the purpose of enabling such authority to ascertain whether such addition, partial construction, entire or partial reconstruction or alteration is in accordance with the statutory provisions relative thereto, and with any by-laws made under section 202 of the Metropolis Management Act, 1855, and, if in any case plans and sections have been previously deposited in conformity with the foregoing by-law No. 1, it shall be sufficient for him to give in writing with the deposit the date of the previous deposit, and to show the new work on the plans and sections to be deposited, and only so much of the existing work as will enable the sanitary authority to see the relative positions of the new and old work.

Provided that this by-law shall not be deemed to require the deposit of any plans, sections or particulars in the case of any repair which does not involve the alteration or the entire reconstruction of any pipe, drain, or other means of communicating with sewers or the traps and apparatus connected therewith.

Alterations of drains in cases of urgency.

3. (1) In any case in which an alteration of the drains must be carried out at once, every person who is about to carry out such alteration shall, in lieu of depositing the plans, sections, and particulars referred to in these by-laws, forthwith send to the sanitary authority of the district a notice in writing of any such proposed alteration.

(2) He shall also within two weeks of the commencement of such alteration make the deposits required by these by-laws.

Penalty.

4. Every person who shall offend against any of the foregoing by-laws shall be liable for every such offence to a penalty of two pounds, and in the case of a continuing offence to a further penalty of twenty shillings for each day after written notice of the offence given in accordance with section 202 of the Metropolis Management Act 1855.

Definition of "person."

5. In these by-laws the word "person" includes any body of persons whether corporate or unincorporate.

Exemption of City.

6. These by-laws shall not extend to the City of London.

54, *Bedford Square, W.C., 2nd December* 1903.

To the Hon. Secretary Practice Standing Committee R.I.B.A.

DEAR SIR,—With reference to the question of the new by-laws of the London County Council referred to you at the last meeting of the Council, I would draw special attention to the by-laws made by the London County Council, and approved by the Local Government Board on the 20th August 1903, No. 1, sections 1, 2, and 3, which describe the plans which are to be submitted for the purpose of showing the drainage system of a building.

I would ask the Committee to consider whether this is not a very onerous and unnecessary tax on either the owner, or the architect, or the contractor of a building in London. In fact, it enables a local sanitary inspector or, at all events, his chief, to require a complete set of drawings of a building—plans, sections, and, if exacted, elevations—for the mere purpose of showing the drains, water-closets, lavatories, &c. of a building. It may not matter where it is a small cottage, because the cost of such a thing is small; but where it relates to an extensive building—be it warehouse, show-rooms, block of flats, hospital, or museum—it is a very expensive matter, and, I submit, is more than is necessary for the sanitary purpose kept in view. These plans have also to be supplied in duplicate, and this means two complete sets of plans, in addition to a complete set which has to be supplied to the district surveyor.

The necessity for the deposit in certain buildings of the last-named is perfectly reasonable, because a district surveyor is an officer charged with seeing, broadly speaking, that a building is substantially *constructed* within the provisions of an Act of Parliament.

Many architects have taken exception to parting with a complete set of their designs even under these circumstances, but I feel sure it was never realised, when the sanitary by-laws were under consideration, that so serious an impost was to be put upon professional men.

I would further note that the expense becomes infinitely greater where a large existing building is having a new system of drainage put into it, if by-law No. 2 is interpreted by the sanitary authority to mean that "necessary" plans are all the plans required by No. 1. It would mean the measuring up of the whole of the old buildings, and preparation of complete sets of drawings, for no other purpose than this sanitary requirement.

You will also note that by-law 1, section No. 4, requires a complete specification of all sanitary and other matters.

I submit that if a block plan, as required by section 5, is given, with the levels and gradients properly marked on, this shows them everything that is necessary, as it gives them in effect the longitudinal sections. Beyond this plan a written description of the pipes and apparatus below and above ground would be reasonable.

Yours faithfully,
EDWIN T. HALL.

The Ancient Lights Bill.

The Bill to amend the Law relating to Easement of Light was brought in by Messrs. Fletcher Moulton, K.C., H. D. Green, Herbert Robertson, Robson, and Haldane, and read a first time in the House of Commons on Tuesday, the 9th inst. The Bill, which is the outcome of the labours of a joint committee of the R.I.B.A. and the Surveyors' Institution, will be found printed in the JOURNAL R.I.B.A. for 27th June 1903.

The Prize Drawings for Exhibition in the Provinces.

The following selection from the premiated designs and drawings in the Institute Competitions for Prizes and Studentships 1903–4, together with some studies submitted by candidates for the Intermediate Examination, will be exhibited during the next few months in the districts of the Allied Societies:—

The Royal Institute Silver Medal (Measured Drawings).—Church of St. Oswald, Ashbourne, Derbyshire (3 strainers), by Mr. Laurence M. Gotch ("Dolphin"), awarded the Medal and Ten Guineas; St. James's Church, Piccadilly (2 strainers), by Mr. C. Lovett Gill ("Vis"); and Tideswell Church, Derbyshire (2 strainers), by Mr. G. S. Solomons ("Gothic"), awarded Certificates of Hon. Mention respectively.

The Soane Medallion.—Designs for a University Theatre: 3 strainers by Mr. Frederic J. Horth ("Oxon"), awarded the Medallion and £100; 2 strainers by Mr. David Smith ("Gable Endie"), awarded a Certificate of Hon. Mention.

The Owen Jones Studentship.—Drawings by Mr. W. Davidson (3 strainers), awarded the Certificate and £100; drawings by Mr. H. Morley (1 strainer), awarded Medal of Merit.

The Pugin Studentship.—Drawings by Mr. F. C. Mears (2 strainers), awarded the Medal and £40; drawings by Mr. W. S. A. Gordon (1 strainer), awarded Medal of Merit.

The Tite Prize.—Design for a Crescent in a large City: 3 strainers by Mr. Heaton Comyn ("Bridge"), awarded the Certificate and £30; 1 strainer by Mr. Arthur D. Nicholson ("Porthos"), awarded Medal of Merit.

The Grissell Gold Medal.—Design for a Timber Spire or Lantern Termination; 3 strainers by Mr. J. William Hepburn ("Cardon"), awarded the Medal and Ten Guineas; 1 strainer by Mr. Arthur Jas. Barclay ("Ich Dien"), awarded Medal of Merit.

Testimonies of Study (15 sheets).—Drawings by Messrs. T. L. Dale, J. T. Halliday, O. H. W. Hillerns, W. Stockdale, and H. C. Swindells (*Intermediate Examination*).

New Professor of Architecture at Liverpool.

The Council of the University of Liverpool have appointed Mr. C. H. Reilly, M.A. [*A.*] to the Roscoe Chair of Architecture left vacant by the resignation of Professor Simpson on his appointment to University College, London. Mr. Reilly, who is in his thirtieth year, was a scholar of Queen's College, Cambridge. He graduated, in 1896, in the first class of the Mechanical Sciences Tripos. After leaving Cambridge Mr. Reilly received practical training under his father and in the office of Mr. John Belcher, A.R.A. Since then he has been in practice for three years with Mr. C. Stanley Peach [*F.*]. In the competition for the Liverpool Cathedral his design was selected for honourable mention. For the last three years Mr. Reilly has lectured at King's College, London, on architecture and building construction, and has superintended the work in drawing and design of the day and evening students in the architectural studio. He is a member of the Board of Studies in Fine Arts in the University of London, and has taken an active part in university work.

M. Auguste Choisy [*Hon. Corr. M.*].

M. de Dartein [*Hon. Corr. M.*] contributes to the *Builders' Journal* of the 17th inst. a Biographical Note on M. Auguste Choisy, whose nomination as Royal Gold Medallist for the current year is to come up for confirmation by the General Body at the Special Meeting convened for the 29th inst. In the announcement of the nomination M. Choisy was described as Chief Engineer in the Service des Ponts et Chaussées, but he now ranks as Inspector-General in the Service, having been promoted prior to his retirement last year.

Tenants' Obligations: Some Recent Decisions.

The following cases, determinative of the obligations of tenants for short terms who covenant to pay all outgoings, are noted for reference in connection with the digest of Leading Cases given in chap. xii. of the Practice Committee's book on *Dilapidations*:—

In *Stockdale* v. *Ascherberg* (72 L. J. K.B. 492; L. R. (1903) 1 K.B. 873) the plaintiff agreed to let and the defendant to take a house in Kilburn for three years and then from year to year at the yearly rent of £55, payable quarterly, free of all deductions except landlord's property tax. The defendant agreed to pay all taxes, rates, assessments, and outgoings of every description for the time being payable in respect of the premises. While the defendant was in occupation under this agreement, the Willesden Urban Council served a notice under the Public Health Act upon the plaintiff to repair the drains of the house. The plaintiff did the necessary repairs at a cost of £83, and sued the defendant for this sum. Mr. Justice Wright gave judgment for the plaintiff for the amount claimed, being of opinion that the expenses of doing the work were "outgoings" within the meaning of the agreement. The defendant appealed, but the Court of Appeal on 8th February dismissed the appeal, holding that the word "outgoings" covered such expenses.

In *In re Warriner* (72 L. J. Chanc. 701; L. R. (1903) 2 Chanc. 367), where a house was let to a tenant for three years at a "clear yearly rent of £54," the word "outgoings" did not occur in the covenant; but the Court held that the duty and expense of complying with a notice from the sanitary authority to reconstruct the drains was an "imposition" within the meaning of the covenant which fell on the tenant, notwithstanding the shortness of the tenancy.

In *Harris* v. *Hickman* (73 L. J. K.B. 31; L. R. (1904) 1 K.B. 13) the tenancy, which had originally been for three years, had become a tenancy from year to year at a rent of £70. The owners abated a nuisance arising from defective drainage immediately upon receipt of the intimation of its existence and before service of any notice requiring them to abate it, and it was held that, as they had done voluntarily what they were under no obligation to do, the expenditure was not an "outgoing" within the meaning of the tenant's agreement, in which the word occurred. The amount of the expenditure exceeded a year's rent of the property, and Mr. Justice Wright considered that the tenant in holding over after the expiration of his term and paying rent could not be presumed to have intended to become a yearly tenant on the terms of being obliged to abate such a nuisance.

MINUTES. VIII.

At the Eighth General Meeting (Ordinary) of the Session 1903–04, held Monday, 15th February 1904, at 8 p.m.—Present: Mr. Aston Webb, R.A., *President*, in the chair, 23 Fellows (including 11 members of the Council), 28 Associates (including 2 members of the Council), 1 Hon. Associate, and several visitors: the Minutes of the Meeting held 1st February [p. 179] were taken as read and signed as correct.

A Paper on THE BIOLOGICAL DISPOSAL OF SEWAGE FROM ISOLATED BUILDINGS having been read by Professor Frank Clowes, D.Sc., and illustrated by lantern views, the subject was discussed by Dr. Gilbert Fowler, Dr. Armstrong, F.R.S., and others: at the conclusion thereof a vote of thanks was passed by acclamation to the author of the Paper, and also to Dr. Fowler and Dr. Armstrong.

Announcements regarding the next meeting having been made by the Chairman, the proceedings closed, and the Meeting separated at 10 p.m.

SIR JOHN VANBRUGH: ARCHITECT AND DRAMATIST.

By Robert P. Oglesby.

Read before the York Architectural Society, 7th January 1904.

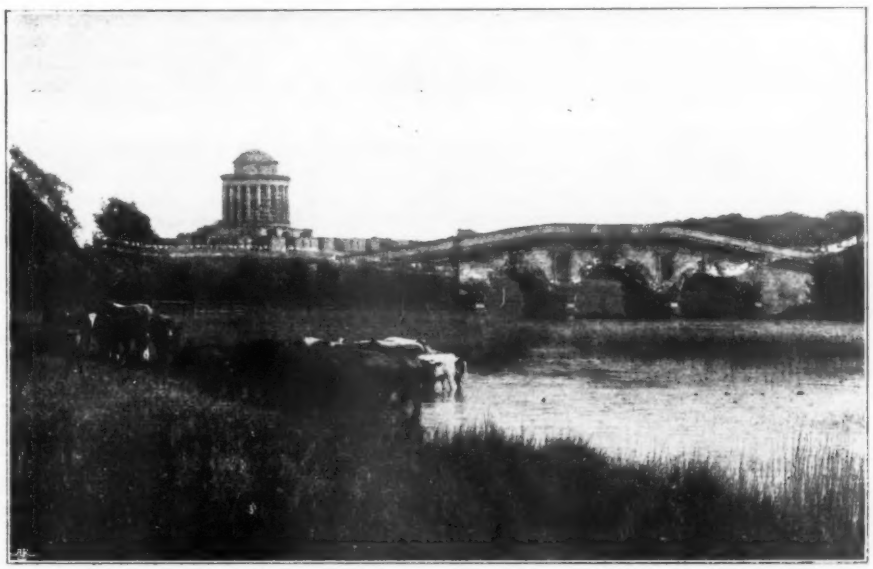


Fig. 1.—Castle Howard: Bridge and Mausoleum.

In attempting to give in the short time at our disposal a *résumé* of the life and works of this remarkable man, it has seemed to me not inappropriate to consider his diverse *métiers* as distinct from one another—the period of his work as a dramatist and his excursions into architecture being to so small an extent concurrent.

With regard to Vanbrugh's origin, it seems pretty well agreed that his forebears hailed from the Low Countries. His father, settling at Chester and amassing a fortune as a sugar baker, afterwards obtained the post of Comptroller of the Treasury Chamber. The subject of our paper was sent to France, whilst in his teens, to complete a liberal education. His sojourn there must have been instrumental in equipping the young dramatist with much of the airy wit and sense of comic situation, not to say freedom of morals, which are such prominent features of his plays.

On his return to England he entered the army as an ensign. In 1695 we find him appointed Secretary to the Commission for endowing Greenwich Hospital, and about two years afterwards his first comedy, "The Relapse," was produced at Drury Lane, obtained an instant success, and secured his reputation as a playwright.

In those days, to be possessed of wit was a sure passport to high society—and Vanbrugh's fine presence, distinguished manner, and agreeable qualities quickly established him at Court as a *persona grata*.

The comedies and adaptations which followed his first effort in no way detracted from, but rather enhanced, his fame. The poet Dryden showed his appreciation by inditing prologues and epilogues to his works. Voltaire referred to him as the gayest, as Walpole considered him the best, writer of dialogue—in fact, he is allotted a high place among dramatists of the time.

In common with his contemporaries, Vanbrugh did not escape the charge of introducing indecorous elements into his plays. A furious attack

on the comedy of manners was led by one Jeremy Collier, who issued a brochure on the subject, in which he laid down that "the business of plays is to commend virtue and discountenance vice." Vanbrugh promptly replied with a pamphlet of vindication, in which he says, "The business of comedy is to show people what they should do by representing them upon the stage doing what they should not. The stage is a glass for the world to view itself in. People ought, therefore, to see themselves as they are. If it makes their faces too fair they won't know they are dirty, and by consequence will neglect to wash them"—which was a witty if not a very strong defence.

Leigh Hunt considers that Collier laboured under the idea that the playwrights were knaves and fiends who had positively malignant intentions; and in so doing he was not aware that he betrayed a vice in his own spirit, which, if they had thought as ill of as he did of their license, would have warranted them in denouncing him as the far greater devil of the two.

However much Collier may have overdone his charges of intention, he certainly forced the writers to consider decorum. Nevertheless, Vanbrugh wrote his defence subsequently to his plays—which were no doubt merely produced for the amusement of the town—without any purpose for good or evil; and for him to profess unconsciousness of their indelicacies, and to further protest that his works might well lie alongside the Bible, can only be looked upon as an exhibition of the purest impudence.

The charge of intention is not borne out by our knowledge of his character. He had sincerity and good nature, and was happily constituted in mind and body. Subsequently both Swift and Pope openly regretted their raillery against a man of wit and honour.

As a comic writer he is always straightforward, cheerful, and robust—something between English and French, without being over nice or giving too much praise to virtue as a convention. He leans towards the virtues which are sound and healthy, and that will always remain so. His temperament was naturally opposed to hypocrisy. The license of the period must be responsible for the plainness of speech which his high spirits did not tend to repress.

Of feeling, in the sentimental sense, he possessed little. But his plots are always interesting, and free from complexity. Whatever ideas he borrows from other writers he seems to change into something better by sheer sleight of hand: an example which those amongst us who contend that there can exist no originality that is not founded on tradition, would do well to emulate.

Although one may say with Pope, "How Van wants grace, who never wanted wit," the fact remains that Vanbrugh's tradition had a large influence upon the production by Colman, Goldsmith, and Sheridan of the best plays of the eighteenth century.

The line which divides Vanbrugh's work as a playwright and his career as an architect, is clear and decided. Nor can the slightest evidence be found of any previous architectural education, or even inclination, which would account for this transition, much more warrant him in being trusted with schemes of such magnitude as fell to his lot. We hear whispers of architects of repute having ghosts; Pecksniff certainly possessed one. But it is not probable that Vanbrugh traded upon another's talent, for he would quickly have been exposed during the building of Blenheim by the Duchess of Marlborough, whose dislike of him amounted almost to a vendetta.

There was, in a sense, a slight overlapping of vocations, inasmuch as his first completed architectural work was a theatre in the Haymarket.

This sudden leap from the Drama to Architecture was taken as a glorious joke by his brother wits and *littérateurs*, who forthwith let loose such a flood of sarcasm and raillery upon his architectural efforts as would have crushed with ridicule any ordinary individual. Swift wrote:—

> Van's genius, without thought or lecture,
> Is hugely turned to Architecture.

A house that Vanbrugh erected for his own occupation on the site of the ruins of old Whitehall, was dubbed by the wits the "Goose-pie;" and Swift issued the following satirical poem, indicating that Vanbrugh found the means to build from the money his plays produced:

> The building, as the poet writ,
> Rose in proportion to his wit—
> And first a prologue built a wall
> So wide as to encompass all.
> The scene—a wood—produced no more
> Than a few scrubby trees before,
> The plot as yet lay deep; and so
> A cellar next was dug below.
> But this a work so hard was found,
> Two acts it cost him underground.
> Two other acts we may presume
> Were spent in building each a room.
> Thus far advanced he made a shift
> To raise a roof with act the fifth;
> The epilogue behind did frame
> A place, not decent here to name.
> Now poets from all quarters ran
> To see the house of brother Van.
> One asks the waterman hard by
> Where may the Poet's Palace lie?
> Another of the Thames enquires
> If he has seen its gilded spires;
> At length they in the rubbish spy
> A thing resembling a goose-pie.

Vanbrugh had no sensitive nature, and being a smart, witty man he was enabled to give harder raps than he received, and continued unconcernedly to think out his colossal schemes, secure in the patronage of the Court and its belief in his ability.

Vanbrugh's first work, as before mentioned,

was a theatre in the Haymarket which occupied the site of the lately demolished "Her Majesty's," now that of the Carlton Hotel. The neighbourhood then was pasture-land, and its distance from the centres of fashion was regarded as a grave error. Moreover, the construction of the house was faulty and the acoustic properties wretched. The famous Colley Cibber, actor and dramatist, mentions that "every sound was lost in it, so as to appear like the gabbling of so many people in the lofty aisles of a cathedral." The house was afterwards altered so effectually as to render the performances audible.

FIG. 2.—CASTLE HOWARD: SOUTH FRONT FROM THE LAKE.

This was not, one would think, a very encouraging start; nevertheless, we next hear of him, in the year 1702, being engaged upon the design and erection of Castle Howard, Yorkshire, for the Earl of Carlisle.

This was the first great scheme of this imaginative but unschooled architect. His want of training is here observable on all hands, but his genius for the picturesque atones for many defects. He seems to have regarded his buildings as so much material for scenic effect at the sacrifice of all suitability for their purpose.

Though Vanbrugh had his detractors, chief of whom was Walpole, who said that he lacked all ideas of proportion, convenience, and propriety, he had nevertheless stout adherents. No less a person than Sir Joshua Reynolds, in his Thirteenth Discourse, writes:—"In the buildings of Vanbrugh, who was a poet as well as an architect, there is a greater display of imagination than we shall find perhaps in any other, and this is the ground of the effect we feel in many of his works, notwithstanding the faults with which many of them are justly charged.

"I can pretend no skill in the detail of architecture: I judge now of the art merely as a painter; when I speak of Vanbrugh, I mean to speak of him in the language of our art. To speak, then, of Vanbrugh in the language of a painter, he had originality of invention, he understood light and shadow, and had great skill in composition. To support his principal object, he produced his second and third groups."

The plan of Castle Howard is a blending of the Palladian and Elizabethan. It contains lengthy corridors, and hardly one fine room. The west block is not completed as originally intended, but was afterwards built (1763) by Carr of York, the architect of Harewood House. The south front is perhaps the most graceful example we have of Vanbrugh's work. He cared nought for rules, as may be seen by the varying height of pilasters belonging to the same order.

I here note a circumstance connected with this façade which seems to have escaped the attention of Vanbrugh's numerous commentators. Messrs. Belcher and Macartney, and Blomfield, in their recent works on the Renaissance in England, have escaped recording a singular fact to which I

will now draw attention. It will be observed (fig. 2) that in the east wing there are, probably through Vanbrugh's want of training, an even number of inter-pilastrations, viz., eight, whereas to the west wing there are nine such spaces. My theory to account for this discrepancy is that Carr of York, in building the west block, added another space, thus correcting what he knew was an offence against classic law.

The vases, terminals, and busts which are in such profusion certainly assist in breaking up the skyline, and give at a distance a decidedly castellated effect to the building. It is doubtless the introduction of this quality which made the style at any rate popular.

The severity of the north front is much relieved by the use of sculpture. Here we see one of the segmental arcades which is absent from Carr's wing. The rapid fall of the ground in front precludes the acquisition of a photograph which would do justice to the composition. The use made of sculpture is observable in the niches between the pilasters.

The Ionic temple, with tetrastyle porticos at one end of the terrace, is again the stalking-horse for urns. The interior is lined with marble. The dome and porticos do not seem to be on very intimate terms with the main body of the temple.

Nicholas Hawksmoor, who was responsible for the mausoleum, has in this case allowed Vanbrugh's influence to pass him by, and produced a scholarly and reserved effect. Horace Walpole jocularly remarks that the mausoleum at Castle Howard would tempt one to be buried alive.

The bridge over the lower part of the lake, with its enormous keystones, is a good example of Vanbrugh's passion for ponderous masonry (fig. 1).

Passing to the interior, the hall is thirty-five feet square and no less than seventy-seven feet high to the ceiling. This height, so out of proportion to its area, gives it a dreary and tunnel-like appearance. It contains a somewhat exuberant rococo mantel.

The chapel is contained in Carr's wing, and was decorated by Kemp.

The Earl of Carlisle was so pleased with Vanbrugh's design that he created him Herald Clarencieux King at Arms. This gave great offence to his brother heralds; in the first place, because he knew naught of heraldry, and secondly because he laughed at it.

The long corridors and high rooms made the Earl anticipate a draughty house; but Vanbrugh satisfied him that on the stormiest nights "not one candle wanted to be put into a lanthorn," and that the building did not require above one pound of wax and two of tallow candles per night to light it more than the Earl's London house.

At Clarendon Building, Oxford, Vanbrugh was associated with Hawksmoor. The enormous scale of the portico would suggest that the building was designed whilst Hawksmoor had fallen under Vanbrugh's influence when assisting him in the erection of Blenheim. The site is led up to by a slight ascent, which greatly helps the dignity of the building. The proportions of the portico are fairly good, and the whole seems to have absorbed what was best in each collaborator. It groups well with the Sheldonian Theatre and Ashmolean Museum. The entablature of the portico is carried round the building, and in the pediments are semicircular windows. The skyline is broken by statues of the Muses.

Seaton Delaval was erected for Admiral Delaval in 1720. It is situated near the coast, a few miles north of Newcastle; but the site is by no means so commanding as is usual with Vanbrugh's buildings. The plan bears certain similarities to Blenheim and Castle Howard; but the central block is rectangular, with colonnades thrown out to connect it with the kitchen on the west and the stables on the east. The wings are regularly designed. The staircases are, contrary to his custom, placed in rectangular towers on either side. Viewed from the north, the large courtyard, with its colonnades, presents a grand monumental effect, and shows that Vanbrugh was not content to do things in any ordinary way; but whilst constantly striving to obtain new effects, he certainly got far on the road to great architecture.

The north front is treated with frowning severity. The channelled Doric columns upon quadrupled cushioned pedestals again indicate Vanbrugh's aversion to superimposed orders. The central portion might have suggested to Hawksmoor his subsequent treatment of the church of St. Mary Woolnoth.

The south front is rendered gracious by a fine Ionic portico. We notice here an absence of his much-loved keystones, and the details are, for Vanbrugh, quite refined. The square towers and octagonal *tourelles* at the angles give a certain baronial tinge to the building, which I might describe as a mediæval wolf ill concealed in a sheep's clothing of Palladian refinement.

Seaton Delaval, regarded as one of Vanbrugh's most successful vagaries, suffered, in 1752, from the effects of a disastrous fire which rendered it uninhabitable to this day.

King's Weston, near Bristol, finished in 1715, was chiefly remarkable for its chimneys, which are formed into a three-sided arcade. Campbell says: "The whole design sufficiently demonstrates the great genius of the architect." And, later, Gwilt remarks: "A beautiful feature in the house is the grouping of the chimneys." To my own opinion I refrain from giving expression. The great hall rises two stories, and, according to Young, is inconvenient on account of a "vast echo." Campbell remarks that "on the first floor is the lodging story, with an attic for the rest of

the family." Vanbrugh's scale was applied to all buildings, large and small; and in this example I think we see him at his worst. Nevertheless, at a distance, the building nestles nicely into its surroundings, and the arcaded chimneys become almost unobjectionable.

Fleurs Castle, Roxburghshire, is the only building of Vanbrugh's that we know of erected outside England. He has gone back to the earlier Renaissance for his inspiration, whilst retaining a decidedly Scottish feeling throughout. The skyline has had so much attention lavished upon it that its general effect is somewhat restless.

Kneller Hall, Hounslow, designed for Sir Godfrey Kneller, the painter, is now a Royal Military School of Music. This is quite early Jacobean in feeling, and affords another rare example of superimposition, as seen by the wing blocks, which are connected on the ground floor by an open arcading with Doric columns.

Grimsthorpe, Lincolnshire, is considered by many to be Vanbrugh's best work. The hall, which occupies the whole space of the front between the angle blocks, is 110 feet in length and 40 feet in height, showing that Vanbrugh was becoming more amenable to recognised proportion. The coupled rusticated columns would seem to be an echo of Seaton Delaval.

At Stowe, Buckinghamshire, he built a large number of garden buildings. The rotunda is in a manner more chaste than usual. To show his appreciation of these buildings Lord Cobham erected a pyramid 60 feet high in Vanbrugh's honour.

In 1716 Vanbrugh was appointed Surveyor to Greenwich Hospital, and designed the central portion of the west side of what is known as King William's block, which is in red brick with stone dressings.

Reserved to the last is Vanbrugh's greatest work "Blenheim," erected by a grateful nation for that famous son of Bellona, John Churchill, first Duke of Marlborough, in recognition of his services to the state, and in commemoration of his glorious victories over her enemies. I may mention that the said grateful nation omitted to vote the necessary funds for its erection, the expense of which was really defrayed from Queen Anne's private purse.

FIG. 3.—CASTLE HOWARD: NORTH FRONT.

Though Wren actually made a plan of a portion of the building, and was then at the zenith of his fame, he was passed over in favour of Vanbrugh, whose influence at Court was paramount. It is a great question whether after all Vanbrugh was not the man to infuse the requisite combination of qualities into the gift of a nation. The edifice was to be not only a palace but a memorial—residential, princely, heroic, monumental. We can conjecture how our architect would be fired at the thought of such a commission. How in imagination he would become a veritable Cyclops, wresting with his giant grasp masses of stone,

fresh hewn from the bowels of some Brobdingnagian quarry, and so, hurling Pelion upon Ossa, create a vast upheaval of masonry which should evince his genius for grandeur, and be emblematical—when came the four corners of the world in arms—of the shock awaiting them from Marlborough's unconquered legions.

Here was his lifetime's opportunity to "stagger humanity." The plan of Blenheim at once stamps Vanbrugh as a man of powerful imagination. It bears a certain similarity to that of Castle Howard, but the quadrant-shaped wings here form façades to suites of rooms instead of being treated as open arcades. The entrance portico leads to an immense hall, which again gives on to a saloon in the centre of the south front. From these are taken corridors feeding the various apartments. The kitchen and stable wings connected by colonnades enclose a vast forecourt. Vanbrugh afterwards learnt that a number of small rooms do not necessarily conduce to good external effect. There is no lack of corridors. The word corridor was evidently new, for we find Vanbrugh explaining to the Duchess: "The word corridor, Madam, is foreign, and signifies in plain English no more than a passage."

The convenience of the inhabitants, or the fact that the distance separating the kitchen from the dining-room was several hundred feet, in no wise disturbed him. These facts in connection with Blenheim did not escape the notice of Pope, whose Muse inspired the following lines:—

> See, sir, here's the grand approach,
> This way for his Grace's coach.
> The spacious court, the colonnade,
> And mark how high the hall is made;
> The chimneys are so well designed
> They never smoke in any wind.
> This gallery's contrived for walking,
> The windows to retire and talk in;
> The Council Chamber for debate,
> And all the rest are rooms of state.
> Thanks, sir, cried I, 'tis very fine.
> But where d'ye sleep, or where d'ye dine?
> I find by all you have been telling
> That 'tis a house, but not a dwelling.

Strictures such as these were perhaps somewhat out of place, applied to a building which is essentially commemorative and monumental. Some idea of its size may be gained from the fact that the total extent of the park front is 850 feet.

Here, again, Vanbrugh begins his composition with a central mass, and throws out subsidiary groups of varying size and height to lead up to his main feature. Reynolds observes that "no architect took greater care that his work did not start abruptly out of the ground." Leading to the park front is a fine avenue, containing a commemorative monument, and shortly is crossed a bridge, in scale colossal even when compared with the house. It originally spanned a small canal. The massive piers here contain 33 rooms, of which the Duchess of Marlborough, in sarcastic vein, wrote:—"That which makes it so much prettier than London Bridge is that you may sit in six rooms and look out of window into the high arch while coaches are driving over your head."

This bridge formed fair game for the wits. Pope, as usual, was to the fore with his epigram:—

> The minnows, as through this vast arch they pass,
> Cry, "How like whales we look!" Thanks to your Grace.

This huge bridge spanning a diminutive canal was such an evident absurdity that the lake was afterwards greatly extended by "Capability Brown," which has rendered the bridge more conformable to its surroundings, but, as Dr. Johnson wittily remarked, drowned Pope's epigram.

The park front, owing to its length, can only be realised at a distance. It thus gains in appearance by the grouping of masses and varying skyline. Although it possesses an air of solidity, there is nevertheless a lightness secured by the disposal of purely ornamental features, the whole combining to give that air of grandeur at which Vanbrugh aimed; in fact, it has been said, and I think with truth, "that no mansion has such a grand appearance as Blenheim."

In the gateway to the kitchen court Vanbrugh's fancy had full play; notice the cannon-balls on the plinth supporting the piers, a reference to military occupations. There is very little at Blenheim which does not form a site for inscriptions. Walpole observes that the Palace and approaches are so plastered over with them that altogether they form an edition of the Acts of Parliament in stone.

The south front is much more severe than Castle Howard. The wing blocks are each surmounted by an attic with pedestals supporting fantastic finials composed of cannon-balls and coronets.

The consoled cornices caused Silvester, the French artist who designed some of the interior decorations, to announce that much of the design was a weak imitation of the Palazzo Farnese at Florence. There is, at close quarters, nothing beautiful about these wing blocks; but we must not forget that Vanbrugh's building was a vast edifice intended to be viewed from a distance, and successfully fulfilled its purpose in such respect.

We hear much talk of the difficulties we present-day architects have to contend with regarding our clients; but Vanbrugh was harassed and obstructed in his gigantic work, and accomplished it under more trying circumstances than perhaps any architect has ever had to contend with.

I have mentioned that the nation omitted to vote the necessary money for the works, and that Queen Anne made all the payments up to her death. After that it was endeavoured to make the Duke of Marlborough responsible for outstanding debts on the building. The Duke had taken great care not to allow himself to be associated with the financial side of the question. Vanbrugh had repeatedly made unsuccessful attempts to surprise

him into approval of designs and alterations, but the self-possessed Marlborough was not to be drawn. It was no use trying to spring anything upon the Hero of Ramillies. Swift describes him as a man of "wonderful presence of mind, so as hardly ever to be discomposed, of a very clear head and sound judgment, detestably covetous." He certainly dribbled out a little money from time to time, protesting all the while that he had nothing to do with the matter.

In the meantime Vanbrugh himself furnished money from his private purse to quieten the workmen. Upon the Duke's death, his widow attempted to saddle the architect with the indebtedness. This was the beginning of the celebrated battle between them, in which this extraordinarily able woman showed her capacity for detail. The smallest item of wages or expenditure failed to escape her notice, and every letter of Vanbrugh's was preserved and covered with spiteful endorsements.

In 1720 she brought a lawsuit, seeking to make him responsible for all debts since the Queen's death; but the bar of the House of Lords declared that Vanbrugh was not liable, and that the debts must be settled by the Duke's executors. The Duchess revenged herself on Vanbrugh by dismissing him from his post. She even refused him a sight of the completed building when he arrived from Castle Howard with his wife.

Vanbrugh married rather late in life. He writes: "If I am going to make a blunder it is better to do so at the end of one's life than at the beginning of it." His wife was a daughter of Colonel Yarborough, of Heslington, near York. I quote, on this subject, a letter written by Lady Mary Wortley Montagu, as follows:—

> I can't forbear entertaining you with our York lovers—love being as much forced up here as melons; and for those that don't regard worldly muck there's extraordinary good choice indeed. I believe last Monday there were two hundred pieces of women's flesh (fat and lean). In the front form is even Mr. Vanbrugh; but you know Van's taste always was odd. His inclination to ruins has given him a fancy for Mistress Yarborough.

This delicate epistle, written in her ladyship's twentieth year, gives us some idea of the state of contemporary society.

But to return. The Duchess certainly treated Vanbrugh badly; and she is the only person on record against whom he nursed any resentment. He alludes to her as "that wicked woman of Marlborough"; and again, in a letter: "The Duke has given his widow—(may a Scottish Ensign get her)—£10,000 a year to spoil Blenheim her own way, and £12,000 to keep herself clean and go to law." And, still again: "I have been forced into Chancery by that B.B.B. the Duchess of Marlboro'; but I got my money in spite of the hussy's teeth." Leigh Hunt observes that the meaning of this formidable line of B's may be guessed at from parallel remarks by Shakespeare on "heaths."

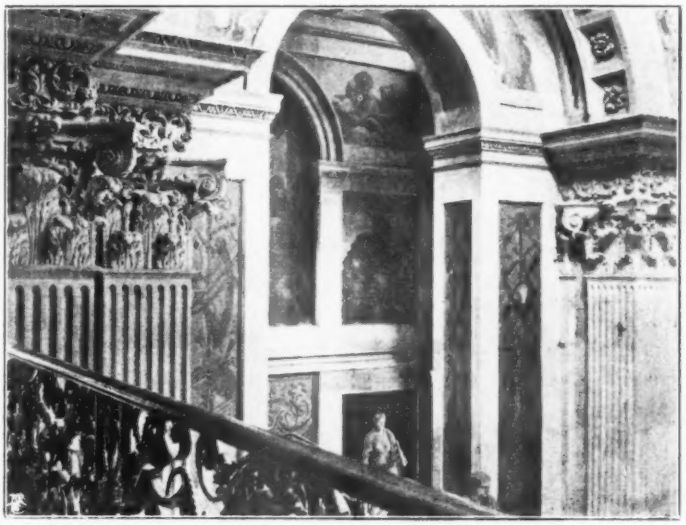


FIG. 4.—CASTLE HOWARD: UPPER PART OF HALL FROM GALLERY.

On Vanbrugh's own authority he received £400 per annum for his work here, but he looked upon this as an honorarium. Hawksmoor was employed for some time as clerk of works, and grumbled that he had only received half that salary whilst doing the greater part of the work.

That we might do well to emulate Vanbrugh's

care in his estimates is illustrated by a letter to Sir Robert Walpole regarding a projected Garden House, in which he says:—

> I have made an estimate of your fabrick, which comes to £270; but I have allowed for doing some things in it in a better manner than perhaps you will think necessary—so I believe it may be done for £200.
>
> But for your further satisfaction I desire that you will send your clerk of works to me, and I will explain it so to him that he may likewise make a calculation without showing him mine or telling him what I make the expense amount to in the total, and when this is done, we will give each particular article to the respective workmen, and they shall make their estimation too, so that you shall know the bottom of it at last, or the Devil shall be in it.

The eastern façade, with its Italian Garden, has the angle towers as its main features. The centre bay is one of the few examples of superimposition by this architect, where we have a comparatively small Doric order surmounted by Persians.

The west front is similar in design, except that the semicircular bay is carried up two stories, which seems to emphasise its want of scale with the remainder. Vanbrugh here suggested the addition of a greenhouse, which should be a most pleasant sitting-room, "for that indeed," he says, "is what I take it to be, and not a magazine for a parcel of foolish plants." The Duchess was furious at the thought of this expenditure, and endorses the letter: "This greenhouse, I thank God, I prevented being built; nothing can be more mad than the proposal."

To pass to the interior—the hall is approached from the north portico, and possesses little grace or refinement; the engaged Corinthian columns in the angles appear particularly lonely. A view looking south is more pleasing; though here, again, we have varying heights of the same order. The hall is 55 feet by 45 feet, and 67 feet high. From the hall we pass to the saloon in the centre of the south frontage, with its marble door dressings and wall paintings. This acts as an inner hall, to serve the apartments on either side. Here is one of the state apartments, containing tapestries illustrative of Marlborough's victories. A number of these rooms have been recently refitted and decorated.

The library, which measures 183 feet in length, extends along the whole of the west front. It is broken up by bays, and was meant to take the place of the long galleries which are such prominent features in the earlier mansions. It is panelled in oak painted white. The columns and pilasters are of marble.

The chapel is reached from this apartment along an open colonnade. It is chiefly remarkable for the great monument to the Duke.

The actual workmanship of Blenheim is admitted to have been admirable. One writer remarks "that so perfectly was the work carried out that it is possible to look through the keyholes of ten doors and see daylight at the end, over three hundred feet away" (!).

In conclusion, however great were Vanbrugh's faults, and notwithstanding his glaring want of refinement and taste, he possessed valuable qualities for his profession; and had he lived longer would no doubt, by further study, have become a really great architect. He certainly conceived of his buildings as a whole and in relation to their surroundings, as Payne Knight observes: "The views from the principal fronts of Castle Howard and Blenheim are bad, and much inferior to what other parts of the grounds would have afforded, but the situation of both as objects to the surrounding scenery are the best that could have been chosen."

The ponderous extravagancies of Vanbrugh, however blamable in detail, are never contemptible in the whole; and amidst all the unmeaning absurdities which the learned observer may discover in the parts of Blenheim and Castle Howard, the general mass in each has been generally acknowledged to be grand and imposing.

Berry, Walpole's editor, quaintly remarks:—

> Large edifices might be erected from the unnecessary excrescences of stone that load his buildings; and however admirable Vanbrugh's structures may be in their present state of perfection, I will venture to guess that their ruins will have far greater effect, not only from their massive fragments, but from the additional piles which conjecture will supply, in order to give a meaning to the whole.

Even after Vanbrugh's death the wits still had their fling at him, and his love for the ponderous in architecture is handed down to posterity by Dr. Evans's witty and not inappropriate epitaph:

> Lie heavy on him, earth! for he
> Laid many heavy loads on thee.